

Name: Shi, Rui
ID: 89-333-4477
DOB: 01/10/1989
Ethnic Origin: Asian/Pacific Islander
Sex: MALE
Citizenship: CH China
Phone: (551) 363-3017
Email: srnttt@mail.ustc.edu.cn

Classification: GRAD PEE
Term/Yr: FALL 2009-2010
Appl Type: GSN
Status Code: 68
Assist Appl: Y
Assist Req: Y
Residence: Non-La Resident

Home Address:

Mailing Address:

Rm 1#109, West Campus
Ustc, Hefei 230027
Hefei, China 230027

BEST TEST SCORES:

Test	Date	Verb	Quan	Writ	Total	Ofcl	Nbr scores
GRE	10/2007	440	790	3.5	1230	N	1
GMAT							
TOEFL (CB)		Sec1	Sec2	Sec3			
TOEFL (PA)		Sec1	Sec2	Sec3			
TOEFL (IB)	09/2008	25	22	23	89	N	1

INSTITUTION(S) ATTENDED:

INSTIT CODE ENROLL TYPE FIRST TERM LAST TERM

Univ of Science & Technology of China

CH12

UG

1S/2006

3S/2009

→ 3.38

DEGREE(S):

INSTITUTION

DATE

GRADE POINT AVERAGE(S):

Enroll Type	Hours Carried	Hours Earned	Qual Points	Hours Failed	Hours Repeat	Hours Incom	NQP Credit	GPA
-------------	---------------	--------------	-------------	--------------	--------------	-------------	------------	-----

GPA for the last two years of first undergraduate degree:

COMMENTS:

DATE

SUBMITTED TO THE DEPARTMENT PRIOR TO EVALUATION

12/04/2008

Evaluator - CG

Eval Status - P

DEPARTMENT RECOMMENDATION:

This applicant is: ☐ APPROVED: ☐ regular admission ☐ probational admission
☐ DENIED

to the degree program in: PEE ELECTRICAL ENGR, PHD for 1S/2010
(Note change to degree program above) (Note change to term above)

Assistantship: ☐ is offered: \$ _____ for 9 mos. (acad yr) ☐ 12 mos. (fisc yr)
☐ other: _____
☐ is renewable

Date _____ By _____ NOTE: Signature of Grad Advisor/Dept Head req.

GRADUATE SCHOOL ONLY:

Yr _____ Curric _____ Status Code _____ Corr _____ Date _____ By _____

LSU graduate admission requirements for applicants from

CHINA, People's Republic of	
Degree required	<i>Bachelor's degree</i> earned after four year program, awarded in 1982 or later Higher degrees (equivalent to graduate level): <i>Master's; Doctorate</i>
Minimum required grade point average (GPA)	Grading scale varies by institution. Refer to transcript for scale. Most common equivalent of a B is 80, second most common—75. 80 out of 100 90-100 = A 80-89 = B 70-79 = C 60-69 = D 0-59 = Failure
TOEFL	550 (paper-based) or 213 (computer-based) or 79 (internet-based)
GRE/GMAT	No minimum score set by Graduate School
All of these requirements must be met for a student to be eligible for admission at LSU.	

***Note about required GPAs:** Grading scales vary by institution. Generally, student must have an overall GPA at or above the “second level” of the grading scale. For instance, in the U.S. system, a student from a four-point system (A, B, C, D) must have at least a “B” average for admission. A grading scale should be found on each mark sheet and may sometimes be found on the back of the document.

REMINDER: The applicant must have a transcript (with proof of degree or pending degree) from each institution attended, GRE or GMAT score, and an acceptable TOEFL score prior to admission. If a document is not provided, final admission may be delayed.

This is a brief guide for the internal use of graduate admissions committees. It is not intended to be an exhaustive description of the educational system.

Revised 06/2006 Marina V. Pereira/ LSU Grad Admissions

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LOUISIANA STATE UNIVERSITY
DEPARTMENTAL INFORMATION
Electrical Engineering

APPLICATION:

ENTRY SEMESTER AND YEAR: 1S/2010 Fall 2009
PROPOSED GRADUATE MAJOR: PEE Electrical Engr, PHD
AREA OF CONCENTRATION: Computer

BIOGRAPHICAL:

NAME: Shi, Rui STUDENT NUMBER: 89-333-4477

CURRENT MAILING ADDRESS:

LINE 1: RM 1#109, West Campus CITY: Hefei
LINE 2: USTC, Hefei 230027 STATE: ZIP: 23002
COUNTRY: CH MAIL EXPIRATION: 07/20/2009
E-MAIL ADDRESS: srnttt@mail.ustc.edu.cn
DAY PHONE: 551-363-3017

SELF REPORTED TEST SCORES:

GRE: VERBAL: 440 QUANTITATIVE: 790 WRITING: 3.5 TEST DATE: 10/2007
GMAT: VERBAL: QUANTITATIVE: TOTAL: ANALYTICAL WRITING: TEST DATE:
TOEFL: SECT 1: 25 SECT 2: 22 SECT 3: 23 SECT 4: 19 TOTAL: 89 TYPE I TEST DATE: 09/2008

POST SECONDARY INSTITUTIONS ATTENDED:

CODE	LEVEL	FIRST TERM	LAST TERM	DEGREE	DEGREE DATE
CH12	UG	08/2005	07/2009	Intl Degree	07/2009
Univ of Science & Technology of China				China	

FIELD AND GRADE POINT AVERAGE:

UNDERGRADUATE DEGREE:

MAJOR FIELD: Automation MINOR FIELD:
MAJOR GPA: 3.38 MINOR GPA:
CUMULATIVE UNDERGRADUATE AVERAGE: 3.38

GRADUATE DEGREE (IF APPLICABLE):

MAJOR FIELD: MINOR FIELD:

CUMULATIVE GRADUATE AVERAGE:

SUSPENDED OR DISCIPLINARY?

REASON FOR ACADEMIC SUSPENSION/DISMISSAL

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NAME: Shi, Rui

LIST NO MORE THAN 12 COURSES THAT YOU FEEL HAVE PREPARED YOU FOR THE GRADUATE PROGRAM TO WHICH YOU ARE APPLYING. PLEASE PROVIDE DESCRIPTIVE COURSE TITLES, E.G., ANALYTICAL CHEMISTRY, ECONOMIC THEORY, ETC.

Algebraic Structure
C language programming
Data structure and it's Algorithm
Practice and Application Algorithms
Operating Systems
Mircocomputer Principles and System
Calculus
Linear Algebra
Probability theory and Math.Statist
Computational Methods
Mathematical Physics Equations
Function of Complex Variable

EXPERIENCE:

Sep.2006-Jul.2007: Doing some research on a famous puzzle named Bulls and Cows , created a new mathematical model based on Information Theory for the puzzle, then accomplished an algorithm to solve the problem and gained the best result up to now. A technology report was written to summarize the ac

FINANCIAL INFORMATION:

DO YOU WISH TO BE CONSIDERED FOR AN ASSISTANTSHIP OR FELLOWSHIP? Y

DOES YOUR ENROLLMENT AT LSU DEPEND UPON RECEIVING SUCH AID? Y

DO YOU HAVE AN OUTSIDE FUNDING SOURCE (SELF-SUPPORTING, FAMILY, AGENCY, GOVERNMENT, ETC.)?

ANTICIPATED SOURCE:

REFERENCES:

LETTERS OF RECOMMENDATION ARE HELPFUL IN CONSIDERING YOUR APPLICATION, AND FINANCIAL ASSISTANCE IS RARELY AWARDED UNLESS SUCH LETTERS ARE RECEIVED. LETTERS OF RECOMMENDATION FROM THE FOLLOWING INDIVIDUALS WILL BE SENT TO THE APPROPRIATE DEPARTMENT. PLEASE NOTE THAT SOME DEPARTMENTS HAVE SEPARATE RECOMMENDATION FORMS. PLEASE CONTACT THE RESPECTIVE DEPARTMENT(S) FOR THESE FORMS.

NAME OF REFERENCE	POSITION	ADDRESS
Shuang Cong	Professor	Department of Automation,USTC
GuangZhong Sun	Lecturer	Dept.Computer Science,USTC
Rui Zhang	Lecturer	Dept.Mathmatics,USTC

STATEMENT OF PURPOSE:

PLEASE MAKE A BRIEF STATEMENT CONCERNING YOUR PROPOSED PROGRAM OF GRADUATE STUDY. IN YOUR STATEMENT, YOU SHOULD ADDRESS SUCH MATTERS AS AREAS OF INTEREST, YOUR PLANS FOR DEVELOPMENT, AND (FOR APPLICANTS TO RESEARCH MASTER'S AND DOCTORAL PROGRAMS) POSSIBLE THESIS OR DISSERTATION TOPICS.

The Reason for Pursuing Graduate Studies: My college years really had broadened my eyes as I befriended, learnt and competed with so many bright young minds. In the mean time, I was humble and began to realize that I had achieved nothing. Inspired by the learning atmosphere and outstanding alumnus such as Wei-Wu Hu (father of Loongson), Ya-Qin Zhang (global vice president of of Microsoft) and Yuan-Qing Yang (CEO of Lenovo), I was awed by the ever-changing technologies since Renaissance and visioned what a hungry and ambitious mind can achieve with abundance of

NAME: Shi, Rui

opportunities. I also found leisure in college comparing in high school, where the learning is more grade-driven, so I could spend more time thinking and reading biographies of the greatest people in history, such as Newton, Thomas Edison and Albert Einstein. I think it is the people like them, who made great contribution to the society and greatly changed the world that should be remembered and honored for centuries. Every time I saw the great changes made by technology, it is hard to suppress the feeling of exciting. As a result, I choose to be an expert in IT and do some contribution to the development of technology. Motivated by interest, I devoted much of my time in research, during which I find that I have a lot of knowledge to learn. So I feel it is absolutely necessary for me to continue my research and pursue Ph.D. degree. The Reason for Admission to LSU: The graduate program in computer science at LSU has been well known. Novel ideas and thoughts have been the moving force for modern science and technology. The researchers in LSU have the top of them. I am really interested in the field of Computer Graphics researched by Professor Li in your school. We also had some contacts, during which I found it will be a privilege for me to learn from him. Fields of Interest: My areas of interest include Computer Graphics, Algorithm and Networks. After being admitted to your institute, if my background isn't too sufficient, I will take some undergraduate courses to make up for it. I firmly believe that with my academic background and research experience, I will be able to undertake my studies and research effectively.

APPLICATION FOR ASSISTANTSHIP / SCHOLARSHIP

Scholarship (without duties) _____

Assistantship (part-time duties): Teaching ☒ Laboratory _____ Research ☒

Your Name: Shi Rui
(Last) (First) (Middle)

Permanent Address: RM 1-109, West Campus, USTC

Present Address: _____

E-Mail Address: srnttt@mail.ustc.edu.cn

LSU I.D.#: 89-333-4477 Birthdate: 01

Probable degree sought: PhD Admission Term: Fall 2009

Educational Summary:

	Name of Institution	Years Attended	Degree/Diplomas	GPA/Rank
College or University	University of Science and Technology of China	4	Bachelor	3.38
Technical, Professional, or Special Study				

TOEFL Score: 89 Date Taken: Sep.2008
GRE Scores: V 440 Q 790 A 3.5 Date Taken: Oct.2007

Summary of graduate work taken elsewhere _____

Academic/Research Experience _____

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Honors, awards, academic distinctions, memberships _____

List of at least three references you have requested to write to us concerning your suitability and qualifications for the appointment sought:

	NAME	POSITION	ADDRESS
1.	Shuang Cong	Professor	Department of Automation,USTC
2.	GuangZhong Sun	Lecturer	Department of Computer Science,USTC
3.	Rui Zhang	Lecturer	Department of Mathematics,USTC

Area of Interest (you must specify one area):

Circle One: ☒ Computers Communications Electronics Power Systems

What specific reasons prompt you to apply to Louisiana State University for an appointment?

NOTE: It is important that you check the appropriate response below:

☐ I will

be able to attend LSU if financial assistance is not provided for me.

☒ I will not

Rui Shi
Signature

11/26/2008
Date

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MAIL DIRECTLY TO: Dept. of Electrical & Computer Engr., Louisiana State University, Baton Rouge, LA 70803-5901

Rui Shi

Address:
RM 1-109 West Campus USTC
Hefei Anhui 230027
P. R. China

Dormitory: +86-551-3633017
Cell: +86-13615601055
Email: srnttt@mail.ustc.edu.cn

Education: University of Science and Technology of China, Anhui, China Aug.2005 – Present
Department of Automation
Bachelor of Engineering Degree expected June 2009
Average Grades: 84/100 Overall GPA: 3.37/4.0 Overall Math GPA: 3.82/4.0

Academic Experience:

- Sep.2006-Jul.2007: Doing some research on a famous puzzle named "Bulls and Cows", created a new mathematical model based on Information Theory for the puzzle, then accomplished an algorithm to solve the problem and gained the best result up to now. A technology report was written to summarize the achievement.
- Sep.2007-Jul.2008: I took part in a research group in Advanced Control Lab and did some research on Machine Vision Based Control System. Using image as feedback to control a robot arm system. The project is a joint of Computer Vision, image processing and Control Theory. I greatly improved the performance of the system and one paper will be published soon.
- Jul.2008 – Present: I am a member in Joint Lab of Network Communication System & Control, Dept. of Automation. I am conducting research in the area of Search Engine, Doing some possible research on designing web crawler and making it more efficient for Large Scale Search Engine. I'm also trying to study the distributed file system for Search Engine.

Publications:

- Optimization of Precision and Speed in Control System of Robot arm with Visual feedback Submitted
- An Algorithms of Bulls and Cows based on Information Theory and a suppose Mathematical Model Preparing for Submit

Honors and Awards:

"Outstanding Student Scholarship"	2007-2008	USTC
"Outstanding Freshman Scholarship"	2005-2006	USTC
"National Biology Olympiad" The Third Prize in Province	2004-2005	High School

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Computer Skills and Tools:

Hardware description languages: VHDL
High-level languages: C, C++, Java
Algorithm development environments: Matlab
Operating system: Windows, Linux
Other : OpenGL, Visual C++

Math Score:

Single Variable Calculus 95	Multivariable Variable Calculus 88
Linear Algebra 94	Algebraic structure 92
Mathematical Physics Equations 88	Probability theory and Statistics 95
Function of Complex Variable 85	Computational Methods 90

Core Courses:

Data Structure	Algorithm analyze and design	Principle of Microcomputer
Algebraic structure	Operating systems	Computer network
C programming	Information theory	Optimization Techniques
Modern Control Theory	Queuing Theory and Network	Principle of Automatic Control
Basis Theory of Circuit	Technology of Sensors	Analog Electronics Technique
Signal processing	Digital Logical Circuit	Management Information System
Computer Control System	Electronic Design Automation	Software Engineering

Standard English Tests:

- GRE: Verbal: 440 Quantitative: 790 Analytical Writing: 3.5 Oct27. 2007
- IBT: Total: 89 Reading: 23 Listening: 25 Speaking: 19 Writing: 22 Sep10.2008

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STATEMENT OF PURPOSE

Academic Background and Preparation

During my years of undergraduate study in University of Science and Technology of China, I devoted much of my time in doing research because of interest. In my second year I started to deal with a famous puzzle named "Bulls and Cows". This puzzle is to guess four different numbers based on the result of your former guess with the least move. I used information theory to model the problem, then construct an algorithm to solve it and got the best result even up to now. A technology report was written to conclude the achievement. From that time point, I discovered my talents and confidence in computer science and decided to do research related to it. From Sep.2007 to Jul.2008 I took part in a research group in Advanced Control Lab and became very active in the project on Machine Vision Based Control System. The project was about using images as feedback to control a robot arm system. The project is an Integration of Computer Vision, Image Processing and Control Theory. I made significant contribution to improve the performance of the system and we have had one publication already. From last July, I have been a member of Network Communication System & Control, Dept. of Automation. I am conducting research in the area of Search Engine, doing some possible research on designing distributed web crawler and making it more efficient for Large Scale Search Engine. During the research, I gained much knowledge and experience in particular areas. More important, I learned how to do research and how to solve complex problems systematically. These precious experiences gave me enough confidence to face great challenges in both research and life.

The Reason for Pursuing Graduate Studies

My college years really had broadened my eyes as I befriended, learnt and competed with so many bright young minds. In the mean time, I was humble and began to realize that I had achieved nothing. Inspired by the learning atmosphere and outstanding alumnus such as Wei-Wu Hu (father of Loongson), Ya-Qin Zhang (global vice president of of Microsoft) and Yuan-Qing Yang (CEO of Lenovo), I was awed by the ever-changing technologies since Renaissance and visioned what a hungry and ambitious mind can achieve with abundance of opportunities. I also found leisure in college comparing in high school, where the learning is more grade-driven, so I could spend more time thinking and reading biographies of the greatest people in history, such as Newton, Thomas Edison and Albert Einstein. I think it is the people like them, who made great contribution to the society and greatly changed the world that should be remembered and honored for centuries. Every time I saw the great changes made by technology, it is hard to suppress the feeling of exciting. As a result, I choose to be an expert in IT and do some contribution to the development of technology. Motivated by interest, I devoted much of my time in research, during which I find that I have a lot of knowledge to learn. So I feel it is absolutely necessary

for me to continue my research and pursue Ph.D. degree.

The Reason for Admission to LSU

The graduate program in ECE at LSU has been well known. Novel ideas and thoughts have been the moving force for modern science and technology. The researchers in LSU have the top of them. I am really interested in the field of Computer Graphics researched by Professor Li in your school. We also had some contacts, during which I found it will be a privilege for me to learn from him.

Fields of Interest

My areas of interest is computer, include Computer Graphics and Algorithm. After being admitted to your institute, if my background isn't too sufficient, I will take some undergraduate courses to make up for it. I firmly believe that with my academic background and research experience, I will be able to undertake my studies and research effectively.

Honors and Awards

"Outstanding Student Scholarship"	2007-2008	USTC
"Outstanding Freshman Scholarship"	2005-2006	USTC
"National Biology Olympic" The Third Prize in Province	2004-2005	High School

Publications

Optimization of Precision and Speed in Control System of Robot arm with Visual feedback	Submitted
---	-----------

An Algorithms of Bulls and Cows based on Information Theory and a suppose Mathematical Model	Preparing for Submit
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Reg. No.: PB05210122			Name: Shi Rui			Birth Date: 01/10/1989			Enrl. Date: 2005/09		
Department of Automation						Grad. Date: 2009/07					
Speciality: Automation						GPA: 3.38					
Course Title (Fall Term)			Gr.	Hr./Cr.	Course Title (Spring Term)			Gr.	Hr./Cr.		
2 0 5	Mechanical Engineering Drawing		72	40/2.0	2 0 6	Basic Physical Education Option		B	40/1.0		
	Single Variable Calculus		95	120/6.0		Multivariable Calculus		88	120/6.0		
	Linear Algebra		94	80/4.0		College English(2)		85	80/4.0		
	College English(1)		75	80/4.0		Basic Physics Experiment		87	54/1.0		
	Basic Physical Education		A	40/1.0		Mechanics and Thermodynamics		93	80/4.0		
	Introduction to Mao Zedong's Thoughts		78	40/2.0		Principles of Marxist Philosophy		85	60/3.0		
	Fundamentals of Laws		69	40/2.0		Electronic Circuits Basic Theory		79	60/3.0		
	Moral Accomplishment for Students		89	40/2.0		Exp. of Electronic Circuits Basic Theory		81	30/5		
	C Language Programming		89	70/2.5		*Communicative Training for College Students		B	40/2.0		
	Computer Culture		87	40/1.0		Algebraic Structure		92	60/3.0		
2 0 6	Physical Education Option(1)		B+	40/1.0	2 0 7	Mathematical Physics Equations(A)		87	60/3.0		
	Function of Complex Variable(A)		85	60/3.0		Computational Methods(B)		90	40/2.0		
	Experiments on System and Control(1)		B+	40/1.0		Control Motor		78	40/2.0		
	College English(3)		70	80/4.0		Sensor Technology		94	40/2.0		
	Comp. and Student-creative Phys. Exp.		86	54/1.0		Modern Physics Experimental Technology		84	54/1.0		
	Electromagnetics		83	80/4.0		Optics and Atomic Physics		75	80/4.0		
	Principles of Political Economy		81	40/2.0		Deng Xiaoping's Thoughts		91	60/3.0		
	Exp. of Linear Electronic Circuits		85	30/5		Digital Logic Circuits		70	60/3.0		
	Data Structure and Its Algorithm		91	100/4.0		Experiment of Digital Logic Circuits		83	30/5		
	Linear Electronic Circuits		67	80/4.0		Practice and Application of Algorithms		A	40/2.0		
2 0 7	Military Theory		Pass	40/1.0	2 0 8	Physical Education Option(2)		B+	40/1.0		
	The EWB5.0 and Simulate Practice		B-	40/2.0		Modern Control Theory		79	80/4.0		
	*Management Psychology		A	40/2.0		Software Engineering		89	60/3.0		
	Management Information System		90	60/2.5		Queue and Queueing Networks		87	40/2.0		
	Operating System		85.5	80/3.5		Fundamentals of Information Theory		81	40/2.0		
	Basic of Digital Signal Processing		83	80/3.5		Computer Network		81	80/3.5		
	Optimization Methods		90	80/3.5		Microcomputer Principles and Systems		82	120/5.0		
	Automatic Control Principles		75	80/4.0		Stochastic Processes		77	40/2.0		
	Experiments on System and Control(2)		82	60/1.5							
	Probability Theory and Math. Stat.(B)		95	60/3.0							
7	▲ Introduction to Global and Environmental Sc		A	40/2.0							

GPA Calculation:

Centesimal Grade 100~95 94~90 89~85 84~82 81~78 77~75 74~72 71~68 67~65 64 63~61 60

Letter Grade A+ A A- B+ B B- C+ C C- D+ D D-

Point Value 4.3 4 3.7 3.3 3 2.7 2.3 2 1.7 1.5 1.3 1

ABF: Absent/Failure; DF: Deferred; I: Incomplete; IV: Invalidation

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Supervisor:

Grad: **LSU - ELECTRICAL & COMPUTER ENGR DEPT**

GPA = $\frac{\sum(\text{Course Credit} * \text{Course GP})}{\sum \text{Course Credit}}$

注册专用章





学号: PB05210122
姓名: 石 瑞

系别: 自动化系
专业: 自动化

GPA: 3.38
学制: 四年本科

课 程 名 称					课 程 名 称				
2005 — 2006 学 年 第 一 学 期	机械制图(非机类)	72	40	2.0	2005 — 2006 学 年 第 二 学 期	基础体育选项	B	40	1.0
	单变量微积分	95	120	6.0		多变量微积分	88	120	6.0
	线性代数	94	80	4.0		综合英语二级	85	80	4.0
	综合英语一级	75	80	4.0		大学物理-基础实验	87	54	1.0
	基础体育	A	40	1.0		力学与热学	93	80	4.0
	毛泽东思想概论	78	40	2.0		马克思主义哲学原理	85	60	3.0
	法律基础知识	69	40	2.0		电路基本理论	79	60	3.0
	大学生思想修养	89	40	2.0		电路基本理论实验	81	30	.5
	C语言程序设计	89	70	2.5		*大学生交往训练	B	40	2.0
	计算机文化基础	87	40	1.0		代数结构	92	60	3.0
2006 — 2007 学 年 第 一 学 期	体育选项(1)	B+	40	1.0	2006 — 2007 学 年 第 二 学 期	数理方程(A)	87	60	3.0
	复变函数(A)	85	60	3.0		计算方法(B)	90	40	2.0
	系统与控制实验(1)	B+	40	1.0		控制电机	78	40	2.0
	综合英语三级	70	80	4.0		传感器技术	94	40	2.0
	大学物理-综合实验	86	54	1.0		大学物理-现代技术实验	84	54	1.0
	电磁学	83	80	4.0		光学与原子物理	75	80	4.0
	政治经济学原理	81	40	2.0		邓小平理论概论	91	60	3.0
	线性电子线路实验	85	30	.5		数字逻辑电路	70	60	3.0
	数据结构及其算法	91	100	4.0		数字逻辑电路实验	83	30	.5
	线性电子线路(A)	67	80	4.0		算法实践及其运用	A	40	2.0
	军事理论	通过	40	1.0					
	电子设计自动化实践与训练	B-	40	2.0					
	*管理心理学	A	40	2.0					
2007 — 2008 学 年 第 一 学 期	管理信息系统	90	60	2.5	2007 — 2008 学 年 第 二 学 期	体育选项(2)	B+	40	1.0
	操作系统	85.5	80	3.5		现代控制理论	79	80	4.0
	数字信号处理基础	83	80	3.5		软件工程	89	60	3.0
	最优化方法	90	80	3.5		排队与排队网络	87	40	2.0
	自动控制原理	75	80	4.0		信息论基础	81	40	2.0
	系统与控制实验(2)	82	60	1.5		计算机网络	81	80	3.5
	概率论与数理统计(B)	95	60	3.0		微机原理与系统	82	120	5.0
	▲地球科学导论	A	40	2.0		随机过程	77	40	2.0
— 学 年 第 一 学 期					— 学 年 第 二 学 期				

毕业论文题目:

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指导教师:
答辩成绩:
评语:

备注:

GPA算法:

百分制 100~95 94~90 89~85 84~82 81~78 77~75 74~72 71~68 67~65 64 63~61 60
五等级制 A+ A A- B+ B B- C+ C C- D+ D D-
学分绩点 4.3 4 3.7 3.3 3 2.7 2.3 2 1.7 1.5 1.3 1

系主任: 

填表人: 

教务处: 

GPA = $\frac{\sum \text{课程学分} \times \text{课程学分绩点}}{\sum \text{课程学分}}$

**GRE****REPORT OF SCORES**

1 OF 1

901 10 1533 M

Your GRE scores have been sent to the authorized recipient at each Institution or fellowship sponsor listed below. Institutions that receive scores on disk are sent scores twice a month.

INSTITUTION OR FELLOWSHIP SPONSOR	INST. CODE	DEPT. CODE	SCORES REPORTED
GI MICHIGAN ST UNIV	1465	0402	G
GI BOSTON U GRAD SCH	3087	0402	G
GI STANFORD UNIV	4704	1301	G
GI U WASHINGTON	4854	1204	G

This score report includes all of your General Test, Subject Test, and Writing Assessment scores earned from October 1, 2002, to the present.

Please check this report for completeness and contact ETS if you have any questions. See the reverse side for an explanation of terms.

For information about interpreting your scores, consult *Interpreting Your GRE Scores*, which is enclosed with this report.

GI = Graduate Institution or Fellowship Sponsor
UI = Undergraduate Institution
G = General Test
S = Subject Test
W = Writing

GENERAL TEST									ANALYTICAL WRITING/ WRITING ASSESSMENT*		
TEST DATE	VERBAL		QUANTITATIVE		ANALYTICAL WRITING		ANALYTICAL		TEST DATE	SCORE	% BELOW
MMYY	SCORE	% BELOW	SCORE	% BELOW	SCORE	% BELOW	SCORE	% BELOW	MMYY		
10/07	440	43	790	92	3.5	18					

NS: No Score. Indicates that no questions were answered in this section.

* Analytical Writing scores earned from the stand-alone administration and/or Writing Assessment scores earned between October 1, 2002, and December 31, 2003.

SUBJECT TEST							
TEST DATE	TEST NAME/SUBSCORE NAME				SCORE	% BELOW	FORMULA SCORE
MMYY							

THIS REPORT IS NOT VALID
FOR TRANSMISSION OF
SCORES TO AN INSTITUTION.

Test scores are not duplicated on subsequent pages of this report.

NAME: RUI SHI
ADDRESS: RMI-109 WEST CAMPUS USTC
HEFEI 23002 7
CHINA

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REGISTRATION #

5005-152

MOST RECENT
TEST DATE:

10-07

DATE OF BIRTH:

01/10/89

PRINT DATE:

11/28/07

**TOEFL**Internet-Based Test Examinee Score Report
for the Test of English as a Foreign Language

Test Date: 13 SEP 2008

Sponsor Code:

Inst. Code: Dept. Code:

Registration Number:	0000 0000 0621 3337	9088	78
Name:	SHI, RUI	3401	78
Gender:	M	0138	78
Date of Birth:	10 JAN 1989	0812	68
Native Country:	China		
Native Language:	CHINESE		



SHI, RUI

230027 安徽 安徽省合肥市中国科学技术大学1号学生宿舍楼109寝室

China

TOEFL SCALED SCORES

Reading	23
Listening	25
Speaking	19
Writing	22
Total Score	89

The face of this document has a multicolored background -- not a white background.

67

Reading Skills	Level	Your Performance
Reading	High (22-30)	<p>Test takers who receive a score at the HIGH level, as you did, typically understand academic texts in English that require a wide range of reading abilities regardless of the difficulty of the texts.</p> <p>Test takers who score at the HIGH level, typically</p> <ul style="list-style-type: none"> • have a very good command of academic vocabulary and grammatical structure; • can understand and connect information, make appropriate inferences, and synthesize ideas, even when the text is conceptually dense and the language is complex; • can recognize the expository organization of a text and the role that specific information serves within the larger text, even when the text is conceptually dense; and • can abstract major ideas from a text, even when the text is conceptually dense and contains complex language.
Listening Skills	Level	Your Performance
Listening	High (22-30)	<p>Test takers who receive a score at the HIGH level, as you did, typically understand conversations and lectures in English that present a wide range of listening demands. These demands can include difficult vocabulary (uncommon terms, or colloquial or figurative language), complex grammatical structures, abstract or complex ideas, and/or making sense of unexpected or seemingly contradictory information.</p> <p>When listening to lectures and conversations like these, test takers at the HIGH level typically can</p> <ul style="list-style-type: none"> • understand main ideas and important details, whether they are stated or implied; • distinguish more important ideas from less important ones; • understand how information is being used (for example, to provide evidence for a claim or describe a step in a complex process); • recognize how pieces of information are connected (for example, in a cause-and-effect relationship); • understand many different ways that speakers use language for purposes other than to give information (for example, to emphasize a point, express agreement or disagreement, or convey intentions indirectly); and • synthesize information, even when it is not presented in sequence, and make correct inferences on the basis of that information.



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RECOMMENDATION FOR GRADUATE STUDY

Electrical & Computer Engineering Department

Louisiana State University

Baton Rouge, Louisiana 70803-5901

Must be completed by the applicant:

Shi

Rui

(Last Name)

(First Name)

(MI)

SSN

01/10/1989

Date of Birth

What degree will you pursue at LSU? PhD

In which department? Electrical & Computer Engineering Department

Name of recommender Suang Cong

In accordance with the Family Education Rights and Privacy Act of 1974, you may waive your right to inspect this recommendation by signing the statement below. Should you decide not to waive the right, you will have access to the recommendation if you enroll in the Graduate School at LSU.

I hereby waive my right of access to this recommendation.

Rui Shi

(signature)

11/1/08

(date)

Must be completed by the recommender:

Name Suang Cong

Title or position Professor

Mailing address scong@ustc.edu.cn

Telephone (include area code)

Suang Cong

(signature)

Nov. 12, 2008

(date)

This recommendation will remain confidential during the admission process and will be used by the Electrical & Computer Engineering Department only in its procedures relative to admission and awarding of fellowships or assistantships. If the applicant has not waived the right of access to the recommendation, it will become accessible to the applicant only after he or she enrolls in the Graduate School. Please write (you may print or type) candidly and analytically about the applicant's qualifications and potential to be academically successful in the field specified above. When you have completed this recommendation, please enclose it in the envelope provided. Seal it, sign it across the seal, and return it to the applicant. If you prefer, you may mail it directly to the Electrical & Computer Engineering Department.

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To the Applicant: This form should be completed by a professor (or a supervisor) under whom you have studied (or taught or worked) who is able to comment on your qualifications for graduate study). Type or print the first five lines yourself.

Your Name: Shi Rui
(Last) (First) (Middle)

Student No. or (SSN) _____ Birthdate: 01/10/1989

Your Address: RM 1-109, West Campus, USTC

To the Recommender: Please rate the applicant with others of the same age and academic level: It is important to the candidate that you give a percentage rating here.

Student population used for comparison 100
(example: current promotion, last 3 years, etc.)

	Lower Third	Middle Third	Upper Third	Upper 10%	Upper 1 %	Not able to judge
Native Intellectual Ability				/		
Competence in his/her Chosen Field					/	
Motivation plus Diligence					/	
Creativity or Research Potential					/	
Potential as a Teacher				/		

On a scale of 0-10, with 10 being the highest, this candidate is ranked 9.

If you wish you can use the rest of this form to transmit to us your comments on the applicant's merits for receiving an award.

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Signature of Recommender

USTC - ELECTRICAL &
COMPUTER ENGR DEPT



中国科学技术大学



UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA <http://www.ustc.edu.cn>

Department of Automation, Hefei, Anhui, 230027, People's Republic of China

Professor Shuang CONG
Department of Automation
University of Science & Technology of China
Hefei, Anhui, 230027, P. R. China
Tel: +86-551-3600710
Fax: +86-551-3603244
Email: scong@ustc.edu.cn

To whom it may concern:

This letter of recommendation is for Rui Shi, who had being doing project in my lab for a year from 2007 to 2008. The first time when he came to ask me to accept him into my lab, I found that this young man had great passion in doing research. He seemed very excited when talking about algorithm and control system. I finally accepted him as a member of my lab although his GPA was not very high. And he proved his ability in research with his effort and intelligence.

Another quality that impressed me is his persistence: he always tries his best to do things and is not afraid of failure. As a full time student, he had many classes to take. In spite of this, he spent almost all his after class time doing research. In order to improve the performance of the control system in my lab, he tried several ways and failed many times. But every time after failure, he could come up with another solution and try again. Finally, he made it and greatly improved the system in two different aspects.

In conclusion, I believe Rui Shi is an intelligent student who has great passion in doing research and could persist in trying. I recommend him to you with confidence and I think he will do very well in your program.

Sincerely yours

Shuang CONG, Professor and Ph. D.

Signature: Shuang Cong

Date: Nov. 10, 2008

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RECOMMENDATION FOR GRADUATE STUDY

Electrical & Computer Engineering Department

Louisiana State University

Baton Rouge, Louisiana 70803-5901

Must be completed by the applicant:

Shi Rui 01/10/1989
(Last Name) (First Name) (MI) SSN Date of Birth

What degree will you pursue at LSU? PhD

In which department? Electrical & Computer Engineering Department

Name of recommender Guangzhong Sun

In accordance with the Family Education Rights and Privacy Act of 1974, you may waive your right to inspect this recommendation by signing the statement below. Should you decide not to waive the right, you will have access to the recommendation if you enroll in the Graduate School at LSU.

I hereby waive my right of access to this recommendation.

Rui Shi 11/2/2008
(signature) (date)

Must be completed by the recommender:

Name Guangzhong Sun

Title or position Lecturer

Mailing address gzsun@ustc.edu.cn

Telephone (include area code)

Guangzhong Sun 11/26/2008
(signature) (date)

This recommendation will remain confidential during the admission process and will be used by the Electrical & Computer Engineering Department only in its procedures relative to admission and awarding of fellowships or assistantships. If the applicant has not waived the right of access to the recommendation, it will become accessible to the applicant only after he or she enrolls in the Graduate School. Please write (you may print or type) candidly and analytically about the applicant's qualifications and potential to be academically successful in the field specified above. When you have completed this recommendation, please enclose it in the envelope provided. Seal it, sign it across the seal, and return it to the applicant. If you prefer, you may mail it directly to the Electrical & Computer Engineering Department.

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To the Applicant: This form should be completed by a professor (or a supervisor) under whom you have studied (or taught or worked) who is able to comment on your qualifications for graduate study). Type or print the first five lines yourself.

Your Name: Shi Rui
 (Last) (First) (Middle)

Student No. or (SSN) _____ Birthdate: 01/10/1989

Your Address: RM 1-109, West Campus, USTC

To the Recommender: Please rate the applicant with others of the same age and academic level: It is important to the candidate that you give a percentage rating here.

Student population used for comparison 80
 (example: current promotion, last 3 years, etc.)

	Lower Third	Middle Third	Upper Third	Upper 10%	Upper 1 %	Not able to judge
Native Intellectual Ability				10%		
Competence in his/her Chosen Field			*		✓	
Motivation plus Diligence					✓	
Creativity or Research Potential					✓	
Potential as a Teacher					✓	

On a scale of 0-10, with 10 being the highest, this candidate is ranked 10.

If you wish you can use the rest of this form to transmit to us your comments on the applicant's merits for receiving an award.

 Signature of Recommender

 Date

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中国科学技术大学



UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA <http://www.ustc.edu.cn>

Department of Computer Science, Anhui, 230027, People's Republic of China

Lecturer GuangZhong Sun
Department of Computer Science
University of Science & Technology of China
Hefei, Anhui, 230027, P. R. China
Email: gzsun@ustc.edu.cn

To whom it may concern:

I am writing this letter of recommendation for Rui Shi, who I had known for 2 years at University of Sci&Tech of China. At that time, he took the course "algorithm analysis and design", which I taught mainly for students majoring in Computer science. To my surprise, I found he is one of the students who could keep up with the high pace of my lectures. Moreover, he seemed very curious in my class and often discuss thought-provoking questions with me after the course. He may not be a genius, but he is definitely an intelligent student. I used to ask students questions many of which are quite difficult and he often gave answers briefly and precisely.

What impressed me most is his creativity. When I was discussing a famous puzzle named "Number Guess" (also named "Bulls and Cows"), I analyzed several exist algorithms in solving this puzzle and encouraged my students to improve the exist algorithms in order to gain a better result. What made me surprise is that he constructed a new model for the puzzle with information theory and then came up an algorithm based on the model. The result was greatly improved from 5.4 to 4.9 which mean that the min time we must use to guess the numbers may be 4 rather than 5. This is the best result even up to now.

Finally, I would like to conclude my recommendation as follows: Rui is a creative student with great intelligence and curious. Thus I recommend him to you and I think he will do very well in your program. Please feel free to contact me if needed.

Sincerely yours

GuangZhong Sun, Lecturer and Ph. D.

Signature: Guangzhong Sun

Date: 11/26/2008

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RECOMMENDATION FOR GRADUATE STUDY

Electrical & Computer Engineering Department

Louisiana State University

Baton Rouge, Louisiana 70803-5901

Must be completed by the applicant:

Shi Rui 01/10/1989
(Last Name) (First Name) (MI) SSN Date of Birth

What degree will you pursue at LSU? PhD

In which department? Electrical & Computer Engineering Department

Name of recommender Rui Zhang

In accordance with the Family Education Rights and Privacy Act of 1974, you may waive your right to inspect this recommendation by signing the statement below. Should you decide not to waive the right, you will have access to the recommendation if you enroll in the Graduate School at LSU.

I hereby waive my right of access to this recommendation.

Rui Shi 11/1/2008
(signature) (date)

Must be completed by the recommender:

Name Rui Zhang

Title or position Lecturer

Mailing address rui@ustc.edu.cn

Telephone (include area code)

Rui Zhang
(signature)

28-Nov
(date)

This recommendation will remain confidential during the admission process and will be used by the Electrical & Computer Engineering Department only in its procedures relative to admission and awarding of fellowships or assistantships. If the applicant has not waived the right of access to the recommendation, it will become accessible to the applicant only after he or she enrolls in the Graduate School. Please write (you may print or type) candidly and analytically about the applicant's qualifications and potential to be academically successful in the field specified above. When you have completed this recommendation, please enclose it in the envelope provided. Seal it, sign it across the seal, and return it to the applicant. If you prefer, you may mail it directly to the Electrical & Computer Engineering Department.

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To the Applicant: This form should be completed by a professor (or a supervisor) under whom you have studied (or taught or worked) who is able to comment on your qualifications for graduate study). Type or print the first five lines yourself.

Your Name: Shi Rui
 (Last) (First) (Middle)

Student No. or (SSN) _____ Birthdate: 01/10/1989

Your Address: RM 1-109, West Campus, USTC

To the Recommender: Please rate the applicant with others of the same age and academic level: It is important to the candidate that you give a percentage rating here.

Student population used for comparison 100
 (example: current promotion, last 3 years, etc.)

	Lower Third	Middle Third	Upper Third	Upper 10%	Upper 1 %	Not able to judge
Native Intellectual Ability				✓		
Competence in his/her Chosen Field					✓	
Motivation plus Diligence					✓	
Creativity or Research Potential					✓	
Potential as a Teacher					✓	

On a scale of 0-10, with 10 being the highest, this candidate is ranked 10.

If you wish you can use the rest of this form to transmit to us your comments on the applicant's merits for receiving an award.

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 Signature of Recommender

 Date



中國科學技術大學



UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA <http://www.ustc.edu.cn>

Department of Mathematic, Hefei, Anhui, 230027, People's Republic of China

Lecturer Rui Zhang
Department of Mathematics
University of Science & Technology of China
Hefei, Anhui, 230027, P. R. China
Email: rui@ustc.edu.cn

Dear Sir/Madam:

I am privileged to write in support of my student Rui Shi. Rui studied my class "Linear Algebra" in the year of 2005, during which time I witnessed his tremendous growth and development from a high school student to a university student.

Rui entered USTC at the young age of 16, a precocious high school graduate. At first, he had some difficulty accepting his place as a young student. But soon, he became one of the few students who can keep up with the high speed of my class. What's more, Rui quickly learned how to study efficiently and showed his talent in math bit by bit. He often discusses problems with me and I found that he usually think over things in a creative way to reach a beautiful answer. Though this way, he got a deeper understanding of this course much more than I required. As a result, he got 94 in this course, which was very high in my class.

I recommend Rui to your program with absolute confidence. As his teacher, I am sure he will continue to do well as he grows in your program and beyond.

Sincerely yours

Rui Zhang, Lecturer and Ph.D

Signature: Rui Zhang

Date: 26 Nov

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Optimization of precision and speed in control system of robot arm with visual feedback

Shuang Cong Rui Shi

Department of automation, university of science and technology of china, hefei 230027

Abstract: in this paper, chess-type plane is used as calibration patterns. We use a new method based on improved SUSAN detecting combined with end executor forecasting to improve the performance of the control system of robot arm with visual feedback. Based on this improved algorithm, we use the images of the executor to gain the coordinates of the end executor in the world coordinate system then use it as feedback to control the movement of the executor. As a result, both precision and speed of the system are greatly improved.

Key words: corner detection; improved SUSAN algorithm; end executor forecasting;

Shuang Cong: Professor, Department of Automation, University of Science&Technology of China

Rui Shi: Student in Department of Automation, USTC with Bachelor degree expected in 2009

An Algorithm of Bulls&Cows based on information theory and a suppose mathematical model

Rui-Shi

Department of Automation, University of Science and Technology of China, P.R.China

Abstract

At the first part of this paper, we bring forward a new model based on information theory for a puzzle named Bulls and Cows, then construct an algorithm to solve it and gained a good result. Lastly, we propose a mathematical model in order to solve the problem theoretically and had some discuss about it..

Keywords

Bulls and Cows, information theory, mathematical model

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An Algorithm of Bulls&Cows Based on Information Theory And a Suppose Mathematical Model

Rui-Shi Guangzhong-Sun

Department of Automation, University of Science and Technology of China, Peoples
Republic of China

Abstract

At the first part of this paper, we bring forward a new model based on information theory for a puzzle named Bulls and Cows, then construct an algorithm to solve it and gained a good result. Lastly, we propose a mathematical model in order to solve the problem theoretically and had some discuss about it..

Keywords

Bulls and Cows, information theory, mathematical model

1. Introduction

The Game of Bulls and Cows is a deductive game for two players: a codemaker and a codebreaker. The codemaker chooses a secret code consisting of four different numbers out of ten Arabic numerals (0 to 9), so the number of possible codes is $10 \times 9 \times 8 \times 7 = 5040$. Then the codebreaker tries to guess the code. After each guess, the codemaker responds with a hint that consists of black and white pegs. A black peg means that a peg in codebreaker's guess is correct in both position and number; a white peg means that a peg in the guess is correct in number but not in position.

Now we re-state the game with a more precise description. The codemaker chooses a secret code (s_1, s_2, s_3, s_4) and make sure that $s_i \neq s_j$ when $i \neq j$, after each guess (g_1, g_2, g_3, g_4) made by the codebreaker, the codemaker responds with a pair of numbers $[B, W]$, where B is the number of black pegs, i.e. the number of positions j such that $s_j = g_j$, and W is the numbers of white pegs, i.e. the number of positions j such that $s_j \neq g_j$, but $s_j = g_k$ for some position $k \neq j$. For example, if the code is $(1, 2, 3, 4)$ and guesses are $(2, 3, 5, 6)$ and $(1, 3, 8, 9)$, the responses are $[0, 2]$ and $[1, 1]$. So the goal of the codebreaker is, bases on the responses, to solve the secret code in the smallest number of guesses.

There is another game named Mastermind that has much sameness with Bulls and Cows. The only difference is that Mastermind don't require $s_i \neq s_j$ when $i \neq j$. Over

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the past there decades, much research has been done on Mastermind but not too many people interested in Bulls and Cows. The traditional way to solve this puzzle is Screening Method: reserve the possible codes based on each respond and choose one as the next guess. This algorithms is based on the symmetry of respond: if the respond is [B, W] when the code is (g_1, g_2, g_3, g_4) and we guess (s_1, s_2, s_3, s_4) then the respond must be also [B, W] when the code is (s_1, s_2, s_3, s_4) and we guess (g_1, g_2, g_3, g_4) . Now the core is how to choose the next guess among the remaining possible codes. Li-Feng Sun use the random way to choose a possible code as the next guess and need 5.472 times in average; Bin Li choose the number which separate the remaining possible codes most equably and got the result 5.268. This paper is organized as the follows.

2. A new algorithms based on information theory

First, we need to introduce some concepts information theory.

Discrete symbols single-source: Source which contains information must have randomness and sent out signals in certain probability, so we can figure it with a random variable. For example, we throw a dice, each side facing up with a random points. We can take this random experiment as a source and put the point number as it's output. We use X to indicate a discrete symbols single-source : the possible value of X is the different symbols the source may output, its state space

$A: \{1, 2, 3, 4, 5, 6\}$. The probability space is $P\{P(X=1)=\frac{1}{6}, P(X=2)=\frac{1}{6}, \dots, P(X=6)=\frac{1}{6}\}$. So

this discrete symbols single-source mathematical model can be fully expressed as :

$$[X \cdot P] = \begin{cases} X: 1 & 2 & 3 & 4 & 5 & 6 \\ P(X): \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{cases}$$

General : a source may be issued r different symbols a_1, a_2, \dots, a_r , corresponding to the probability $p(a_1), p(a_2), \dots, p(a_r)$. We expressed a certain X -Source, the source space can be expressed as:

$$[X \cdot P] = \begin{cases} X: a_1, & a_2 & \dots & a_r \\ P(X): p(a_1), p(a_2) & \dots & p(a_r) \end{cases}$$

To measure the size of the overall amount of information, we define information entropy $H(X)$:

$$H(X) = -\sum_{i=1}^r p(a_i) \ln p(a_i)$$

At this point, our theoretical foundation has described integrally. Now we assume that the remaining numbers are $p_1 q_1 s_1 t_1, p_2 q_2 s_2 t_2, \dots, p_n q_n s_n t_n$ certain

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speculation. Every $p_i q_i s_i t_i$ will be seen as a source, then the next possible responds are $a_1=0A0B$, $a_2=0A1B$, $a_3=0A2B$, $a_4=0A3B$, $a_5=0A4B$, $a_6=1A0B$, $a_7=1A1B$, $a_8=1A2B$, $a_9=1A3B$, $a_{10}=2A0B$, $a_{11}=2A1B$, $a_{12}=2A2B$, $a_{13}=3A0B$, $a_{14}=4A0B$.

Now we discuss $p(a_j)$: For each $p_i q_i s_i t_i$, the respond is a_j if we get it as the next guess and the number of remains is n_j , then $p(a_j) = \frac{n_j}{n}$. Because each $p_i q_i s_i t_i$ has equal possibility being the right code, so we have the possibility of $\frac{n_j}{n}$ to get a_j if the next guess is $p_i q_i s_i t_i$ (n_j is easy to calculate).

Then the state space of $p_i q_i s_i t_i$ is:

$$[X \cdot P] = \begin{cases} X: & a_1 & a_2 & \dots & a_{14} \\ P(X): & \frac{n_1}{n} & \frac{n_2}{n} & \dots & \frac{n_{14}}{n} \end{cases}$$

$$H(X) = -\sum_{i=1}^{14} \frac{n_i}{n} \ln \frac{n_i}{n}$$

Now let's Enter the concrete steps: The first guess is a random guess (the initial source of information is obviously the equivalent). In the following cycle, put $H(X) = -$

$\sum_{i=1}^{14} \frac{n_i}{n} \ln \frac{n_i}{n}$ as inspiration function (procedure has this function to give special

treatment to ensure that $H(X)$ is valued when $p(a_r) = 0$). For each

$p_1 q_1 s_1 t_1, p_2 q_2 s_2 t_2, \dots, p_n q_n s_n t_n$. Choose the $p_i q_i s_i t_i$ that has the largest $H(X)$ as the next guess (we prefer to the number which gives the largest information).

3. Result

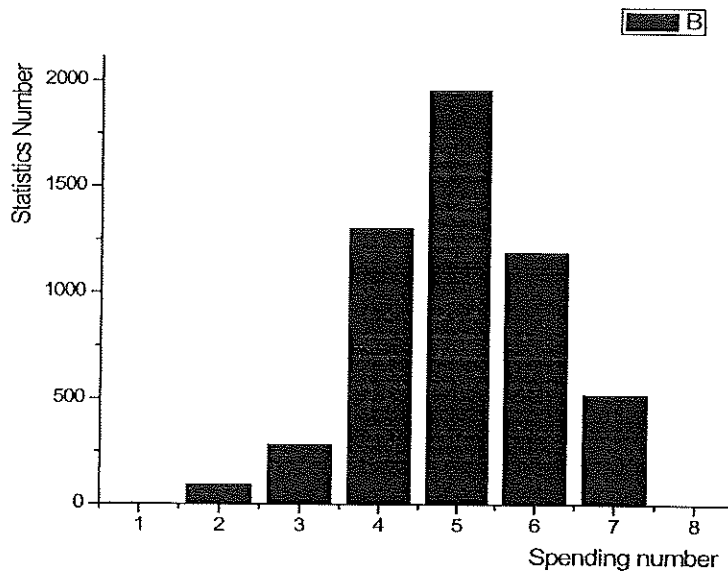
The result (5040 times running with the code from 0123 to 9876):

Spend time	1	2	3	4	5	6	7	8
Static number	5	93	283	1302	1956	1190	521	2

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The average number is 4.89226. Two more experiments had been done with the average number of 4.95397 and 4.9109. So the final average number is 4.917.

4. A suppose mathematical model

We discussed an algorithm based on information theory and got a good result. But this is just an optimization, can't solve the problem theoretically. How many times we need at least to get the code. Now let's discuss it as a mathematical model:

We use (x, y, z, w) to represent four-dimensional vector space, where $x, y, z, w \in 0, 1, 2 \dots 9$ and none of them equal to another. Define "*" in four-dimensional vector space:

$$(x_1, y_1, z_1, w_1) * (x_2, y_2, z_2, w_2) = (a, b)$$

$$\text{Definition of } \delta(p, q) = \begin{cases} 1 & p = q \\ 0 & p \neq q \end{cases}$$

$$\text{where } a = \delta(x_1, x_2) + \delta(y_1, y_2) + \delta(z_1, z_2) + \delta(w_1, w_2)$$

$$b = \delta(x_1, y_2) + \delta(x_1, z_2) + \delta(x_1, w_2) +$$

$$\delta(y_1, x_2) + \delta(y_1, z_2) + \delta(y_1, w_2) +$$

$$\delta(z_1, x_2) + \delta(z_1, y_2) + \delta(z_1, w_2) +$$

$$\delta(w_1, x_2) + \delta(w_1, y_2) + \delta(w_1, z_2)$$

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There are several characters of this operation :

Symmetry :

$$(x_1, y_1, z_1, w_1) * (x_2, y_2, z_2, w_2) = (x_2, y_2, z_2, w_2) * (x_1, y_1, z_1, w_1)$$

Self-certainty :

$$(x_1, y_1, z_1, w_1) * (x_1, y_1, z_1, w_1) = (4, 0)$$

Now we are faced with the problems:

1. We have an unknown (x, y, z, w) , Choose (x_1, y_1, z_1, w_1) and get

$(x_1, y_1, z_1, w_1) * (x, y, z, w) = (a_1, b_1)$. Then choose (x_2, y_2, z_2, w_2) based on the respond above and get $(x_2, y_2, z_2, w_2) * (x, y, z, w) = (a_2, b_2)$ To finalized (x, y, z, w) , how many times should we can spend to decide (x, y, z, w) ?

2. Have an unknown (x, y, z, w) , choose N samples (x_1, y_1, z_1, w_1) , (x_2, y_2, z_2, w_2)

..... (x_n, y_n, z_n, w_n) at the same time , and get a series of responds

$(a_1, b_1), (a_2, b_2)$ (a_n, b_n) . Then how to choose (x_1, y_1, z_1, w_1) ,

(x_2, y_2, z_2, w_2) (x_n, y_n, z_n, w_n) to ascertain (x, y, z, w) ? What's the minimum of N?

My work will stop here because of the limit in math, but I think this problem worth research in depth and there will be more achievement soon.

References

1. Shan-Tai Chen and Shun-Shi Lin(2003)Optimal Algorithms for 2×N Mastermind Games—a Graph-Partition Approach. The Computer Journal 2004 47(5):602-611

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