

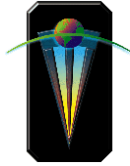
University of Ottawa
School of Information Technology and Engineering

The Relevance of CS and SE Education: A Survey

Timothy C. Lethbridge

**Conference on Software Engineering Education
and Training**

Atlanta, Feb. 23 1998



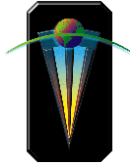
Methodology

168 Participants

Supported by several companies

Some surveys solicited using newsgroups

**4 Questions asked about over 50 topics from
typical curricula**



Demographics - 1

75% Canadian, 22% US

60% Bachelors, 33% Postgraduate

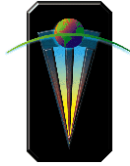
50% CS/SE, 30% Computer Engineering

28% <4yrs work experience

36% >12 years

77% Real-time software developers

34% MIS/In-house software developers



Demographics - 2

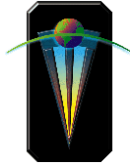
80% Developer

57% Developer, not manager

8% Manager only

34% Manager + other activities

22% Manager & developer



Questions asked:

Question i. How much did you learn about this at University or College?

0=Learned nothing at all.

1=Became vaguely familiar

2=Leaned the basics

3=Became functional (moderate working knowledge)

4=Learned a lot

5=Learned in depth ; became expert(Learned almost everything).

Question ii. What is your current knowledge about this, considering what you have learned on the job as well as forgotten?

0=Know nothing

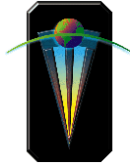
1=Am vaguely familiar

2=Know the basics

3=Am functional; (moderate working knowledge)

4=Know a lot

5=Know in depth/ am expert (Know almost everything)



Questions asked ... continued

Question iii. How useful has this specific material been to you in your career?

0=Completely Useless

1=Almost never useful

2=Occasionally useful

3=Moderately useful, but perhaps only in certain activities.

4=Very useful

5=Essential

Question iv. How useful would it be (or have been) to learn more about this (e.g. additional courses)?

0=Pointless learning more

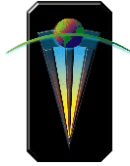
1=Very unlikely to be useful

2=Possibly helpful

3=Moderately helpful.

4=Important to learn more

5=Critical to learn more



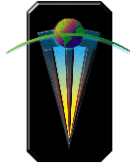
Correlations

Questions 2, 3, 4 correlated (0.9)

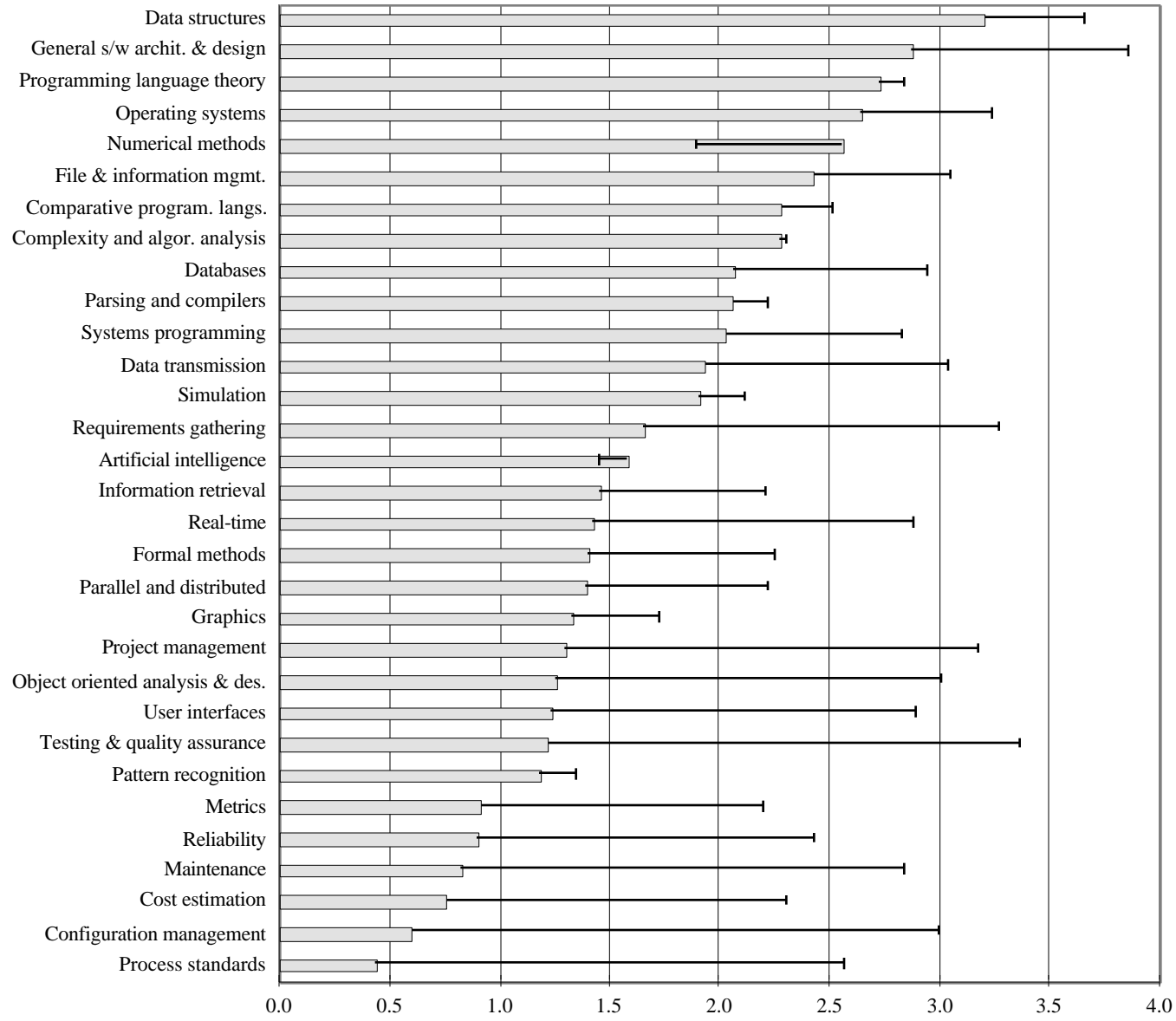
- **Known now, importance, desire to know**

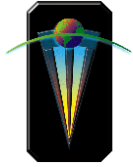
Question 1 uncorrelated with others (0.25)

- **How much learned in university**

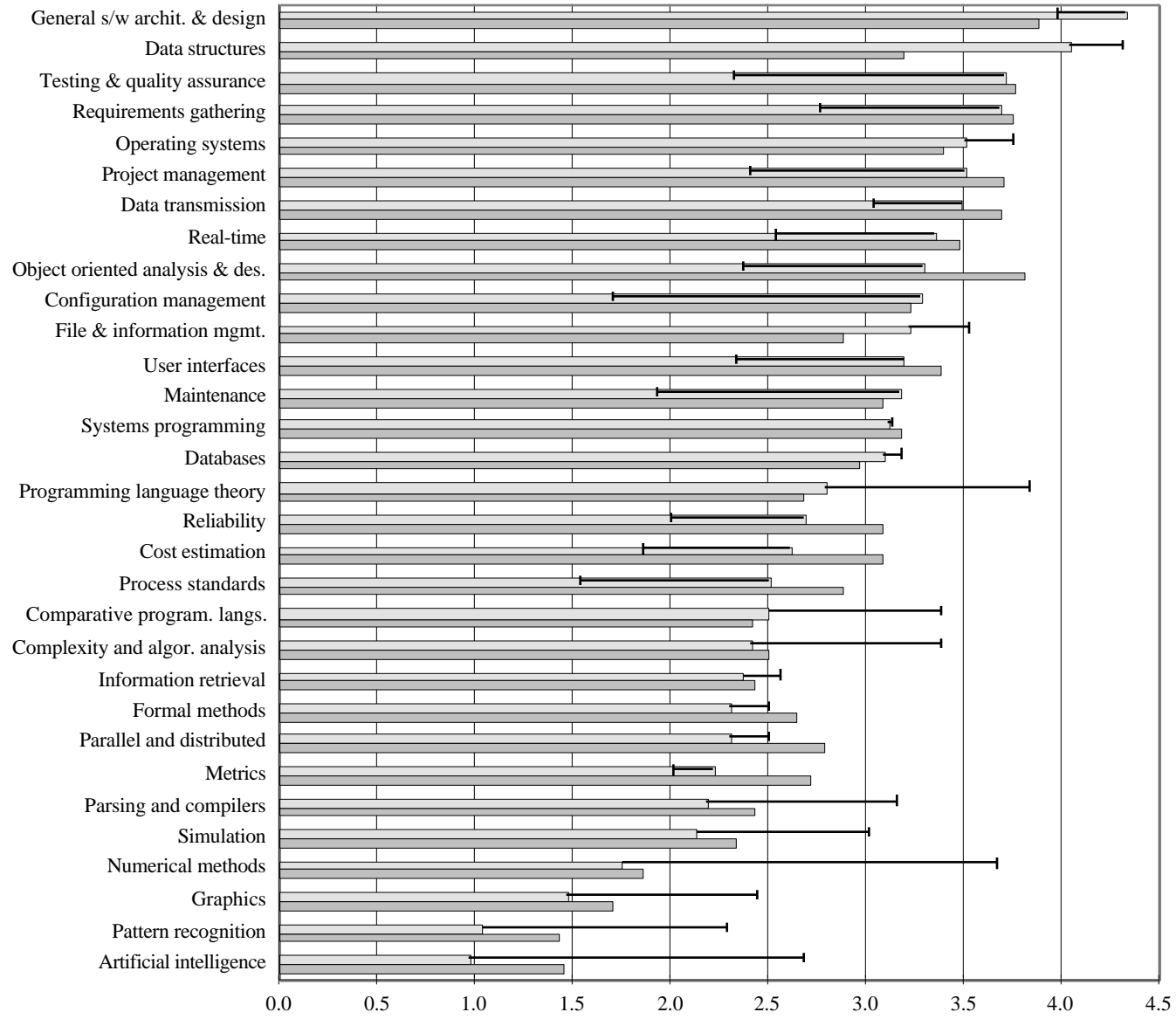


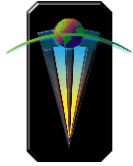
Software – What Was Learned?



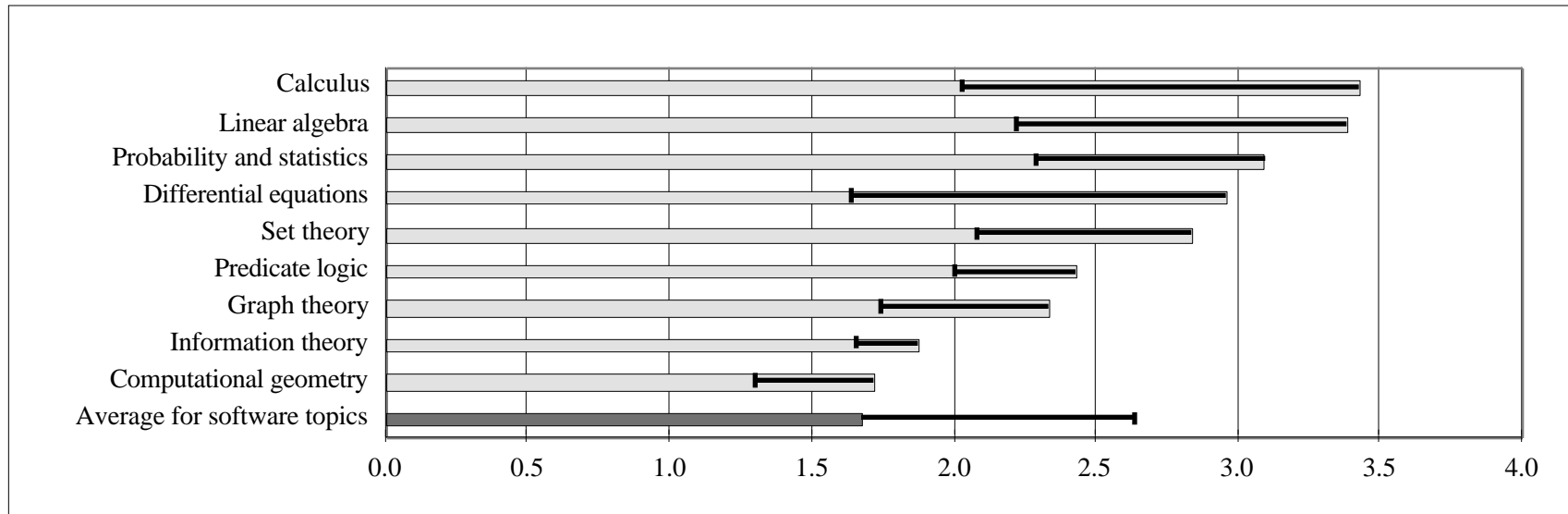


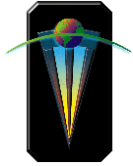
Software – How Important?



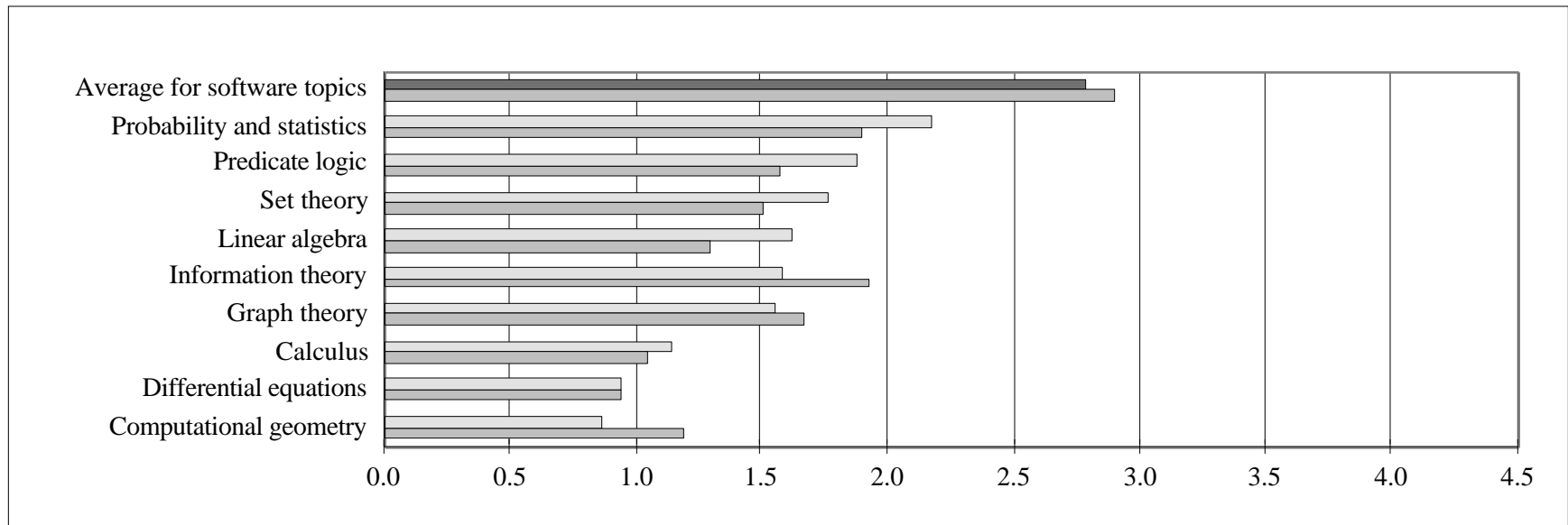


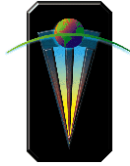
Math – What Was Learned?



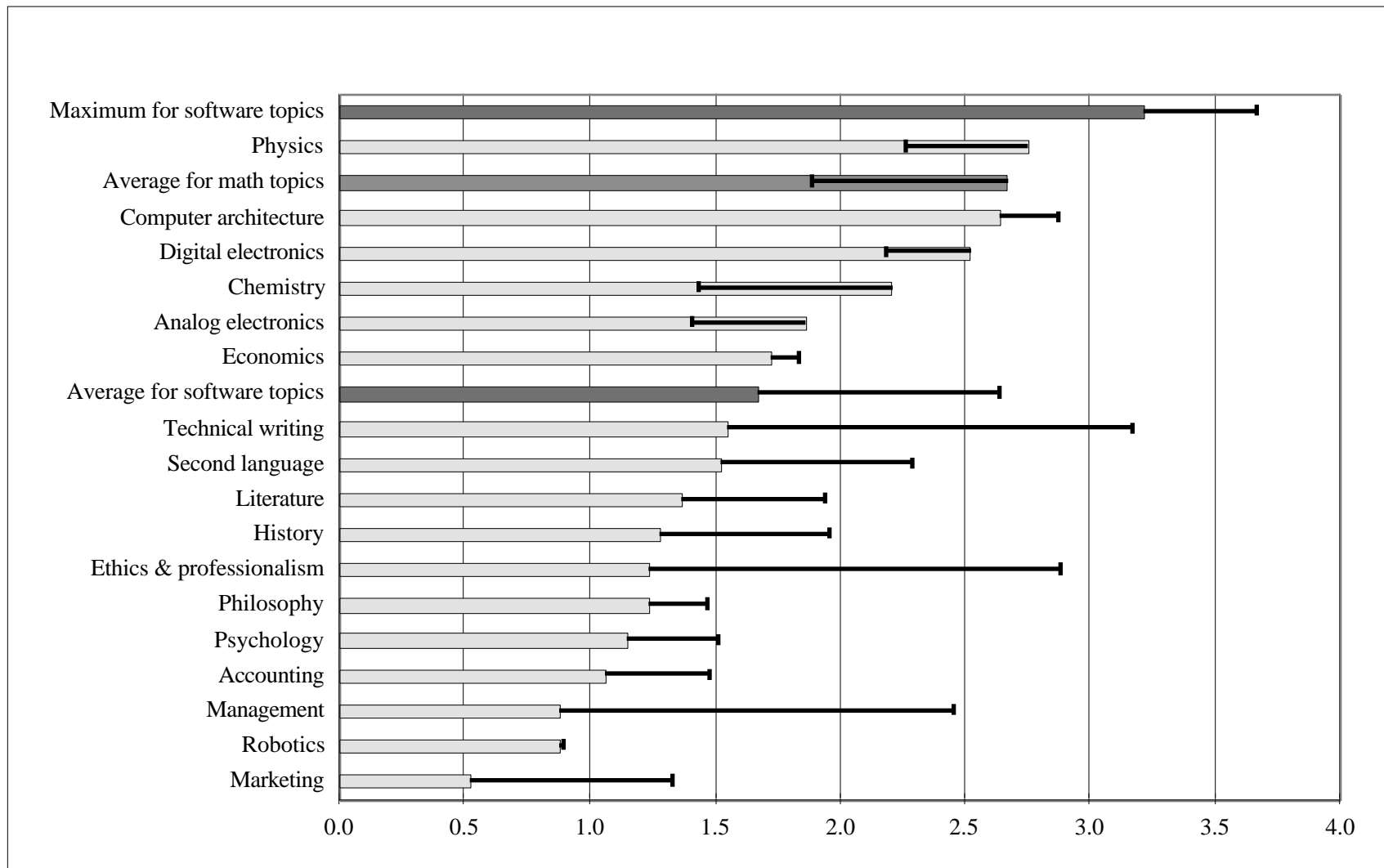


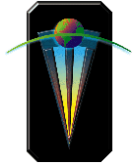
Math – How Important?



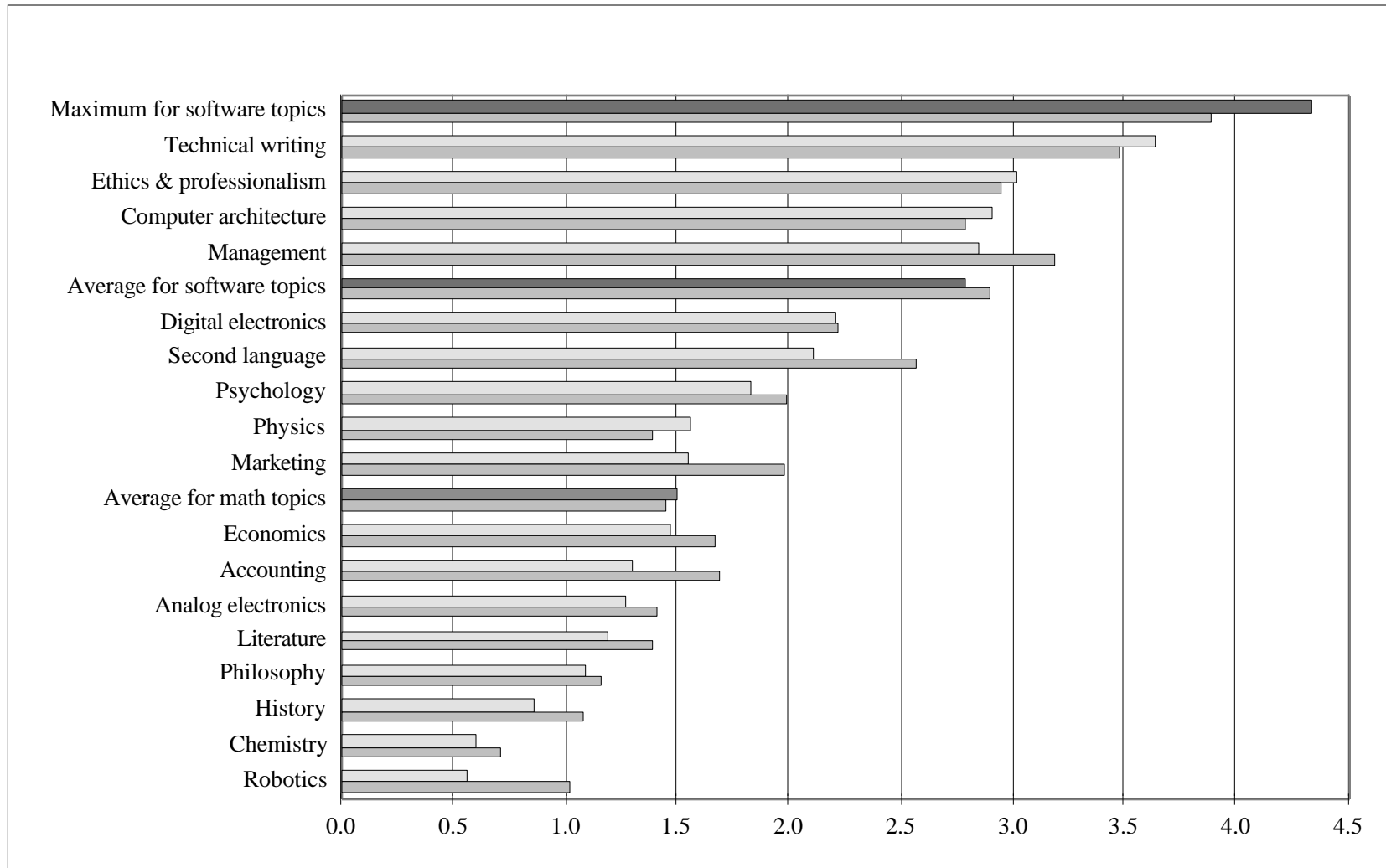


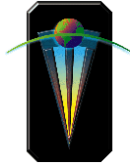
Other – What was Learned





Other – How Important?





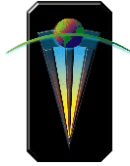
Comparisons within subgroups

Real time developers find more important:

- **Real-time systems**
- **Systems programming**
- **Software reliability**
- **Algorithm analysis**
- **Process standards**

Managers find more important:

- **Project management**
- **Business management**
- **Process standards**
- **Marketing**
- **Accounting**

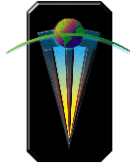


How relevant is your education?

Mean response 3.5 / 5

Percent scoring over 4 / 5:

- **Overall: 51%**
- **USA: 65% Canada: 49%**
- **CS / SE: 70% Computer/Electrical Engg: 30%**
- **Junior: 43% Expert: 56%**

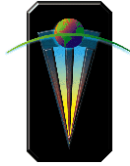


Learning details vs. how to think

Mean response 3.7 / 5 (learning how to think = 5)

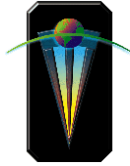
Percent scoring over 4 / 5:

- **Overall: 56%**
- **Outside North America: 44%**
- **With postgraduate education: 67%**
- **Non computer education: 74%**
- **Non-real-time developers: 78%**
- **Junior: 49% Experts: 56%**



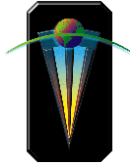
Suggested corporate training

Topic	Importance minus current knowledge
General software architecture and design	0.47
Real-time software development	0.47
Data transmission	0.46
Requirements gathering	0.41
Data structures	0.38
Testing & quality assurance	0.35
Maintenance and reengineering	0.34
Project management	0.33
Cost estimation	0.32
User interfaces / human computer interaction	0.30



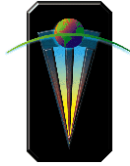
Topics to emphasize more?

Reason for recommended increase in emphasis	Testing	Object orientation	User interfaces / HCI	Technical writing	Ethics & professionalism	Management	Project management	Requirements gathering	Real time systems	Data transmission	Reengineering	Cost Estimation	Psychology	Marketing	Economics	Accounting
Learning required in work force	X	X	X	X	X	X										
Practitioners do not know basics	X		X				X									
Ranked very high in importance	X			X			X	X								
Knowledge low relative to importance, and topic hard to learn on the job			X						X	X	X	X				
Should consider as complementary studies					X	X							X	X	X	X



Topics to emphasize less?

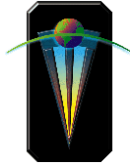
Reason for recommended decrease in emphasis	Numerical methods	Programming language theory	Algorithm analysis	Calculus	Linear algebra	Differential equations
Net loss of knowledge following graduation	x			x	x	x
Low importance with respect to emphasis	x	x	x	x	x	x



Application: New SE Program at the University of Ottawa

Focus on software design and architecture

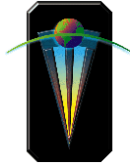
- **The following 3rd and 4th year material builds on second-year foundation:**
 - **Advanced object oriented analysis/design**
 - **User interface design**
 - **Real-time systems**
 - **Telecommunications software**
 - **Computer security**



New SE Program ...

Focus on developing and managing large high-quality systems

- **Four courses in:**
 - **Development of large systems**
 - **Evolution and reengineering**
 - **Quality and requirements**
including formal techniques, testing etc.
 - **Project management**



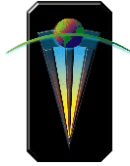
New SE Program ...

Telecommunications sequence

- **3 required courses in 3rd and 4th year**
 - plus 1 elective
- **Builds on expertise in department**

Business/entrepreneurship sequence

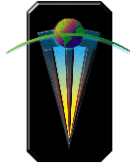
- **Courses in economics, management, and starting a small business**
- **Other business electives to provide background for students who will design business systems**



New SE Program ...

Designed so it can be approved by the Canadian Engineering Accreditation Board (CEAB)

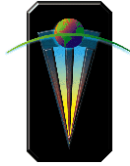
- **If approval is received, graduates will be eligible for the P.Eng. designation following work experience**
- **Common first-year with the rest of engineering**



New SE Program ...

FIRST YEAR (Threshold courses)

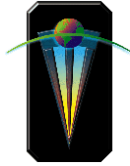
SUBJECTS			Hours per week			
			Fall		Winter	
			Lectures	Lab	Lectures	Lab
CHM	1310	Principles of Chemistry	3	2	-	-
CSI	1102	Fundamentals of Software Dev.	-	-	3	2
ELG	1100	Intro. to Elec. & Comp. Eng.	-	-	3	3
ENG	2112	Technical Report Writing	3	0	-	-
GNG	1100	Engineering Mechanics	3	3	-	-
	1101	Funds. of Computing for Eng.	3	3	-	-
MAT	1320	Calculus I	3	0	-	-
	1322	Calculus II	-	-	3	0
	1341	Linear Algebra I	-	-	3	0
PHY	1104	Fund Physics	-	-	3	-
	1304	Physics Lab	-	-	-	3
TOTAL			15	8	15	8



New SE Program ...

SECOND YEAR

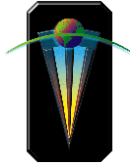
SUBJECTS			Hours per week			
			Fall		Winter	
			Lectures	Lab	Lectures	Lab
ADM	2300	Intr. to Business Management	3	0	-	-
CSI	2114	Data Structures	2	2	-	-
	2131	File Management	-	-	2	2
ECO	1192	Economics for Engineers	3	0	-	-
ELG	2181	Digital Computer Organization	-	-	3	3
MAT	1361	Logic & Discrete Mathematics	3	0	-	-
	2343	Discrete Mathematics	-	-	3	0
	2377	Probability and Statistics	-	-	3	0
SEG	2100	Software Design 2	3	3	-	-
	2101	Software Design 3	-	-	3	3
Two options (see later)			3	0	3	0
TOTAL			17	5	17	8



New SE Program ...

THIRD YEAR

SUBJECTS			Hours per week			
			Fall		Winter	
			Lectures	Lab	Lectures	Lab
ADM	3313	Small business management	-	-	3	0
CSI	3317	Database Management Systems	3	0	-	-
	3310	Operating System Principles	-	-	3	1
	3105	Alg. Analysis and Design	-	-	3	0
CEG	3391	Microprocessor-Based Systems	3	3	-	-
ELG	3300	Intro. Telecom. Systems and Services	3	3	-	-
SEG	2910	Professional SW Engineering Practice	1	0	-	-
	3100	Software Dev. of Large Systems	3	3	-	-
	3110	Adv. Object Oriented Anal & Design	-	-	3	3
	3120	User Interface Analysis & Design	-	-	3	3
	3150	Telecom. Software Engineering	-	-	3	3
One option (see later)			3	0	-	-
TOTAL			16	9	18	10



New SE Program ...

FOURTH YEAR

SUBJECTS			Hours per week			
			Fall		Winter	
			Lectures	Lab	Lectures	Lab
CEG	4161	Real Time Systems	3	3	-	-
CSI	4138	Computer Security	-	-	3	3
ELG	4181	Computer Communications	3	3	-	-
SEG	4100	Project Mgmt.	3	3	-	-
	4111	Software Quality Engineering	3	3	-	-
	4115	Software Evolution & reengineering	-	-	3	3
	4900	Software Engineering Project	-	-	3	3
Three credits in complementary studies			-	-	3	-
HIS	2129	Technology, Society & Environ.				
		or				
PHI	2394	Scientific Thought and Social Values				
Four options (see later)			6	3	6	6
TOTAL			18	15	18	15