The Relevance of CS and SE Education: A Survey

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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=<u>Learned nothing</u> at all.
1=Became <u>vaguely familiar</u>
2=Leaned the <u>basics</u>
3=Became <u>functional</u> (moderate working knowledge)
4=Learned <u>a lot</u>
5=Learned <u>in depth</u> ; became <u>expert</u>(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=<u>Know nothing</u>
1=Am <u>vaguely familiar</u>
2=Know the <u>basics</u>
3=Am <u>functional</u>; (moderate working knowledge)
4=Know <u>a lot</u>
5=Know <u>in depth</u>/ am <u>expert</u> (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

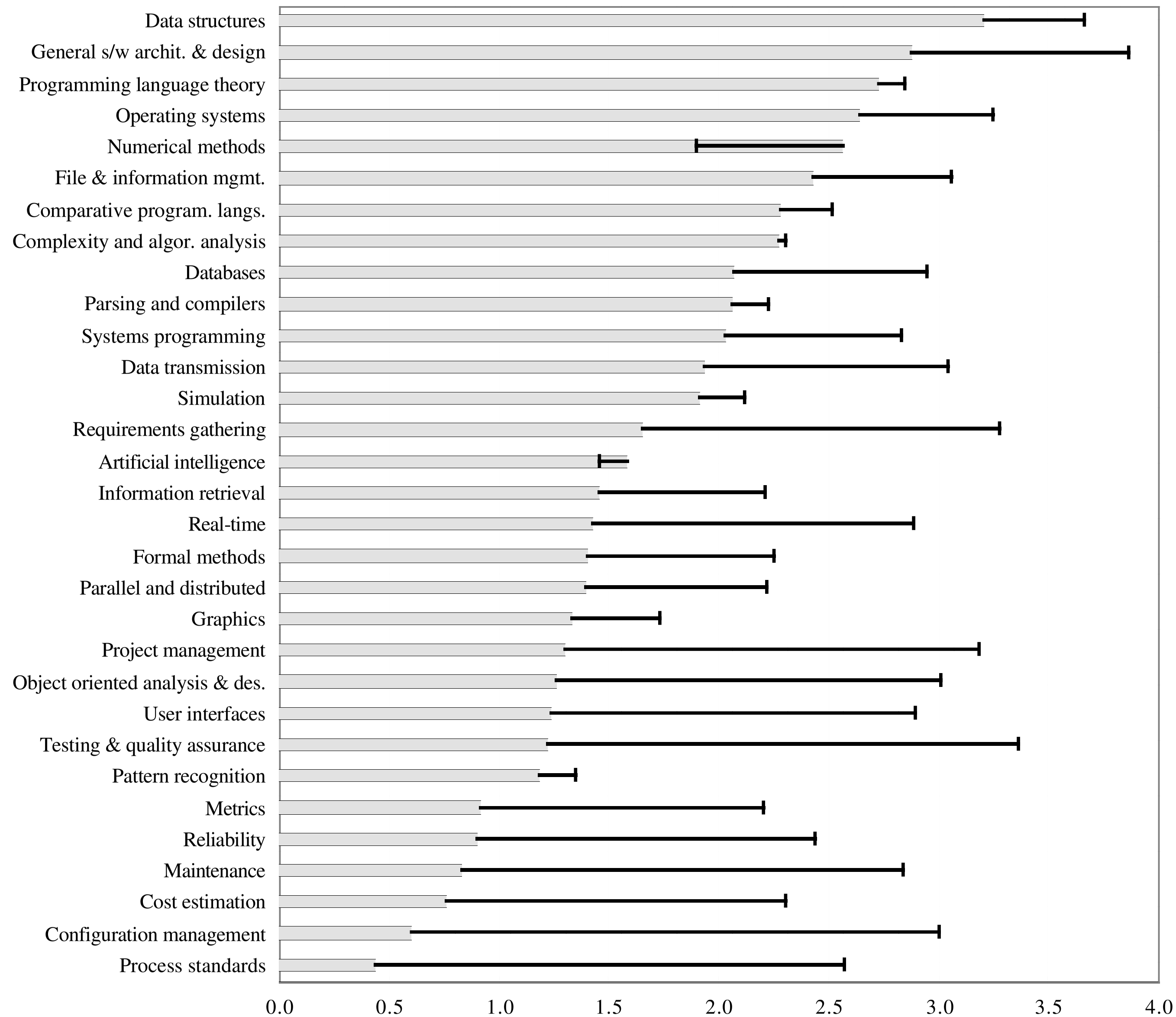
Questions 2, 3, 4 correlated (0.9)

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

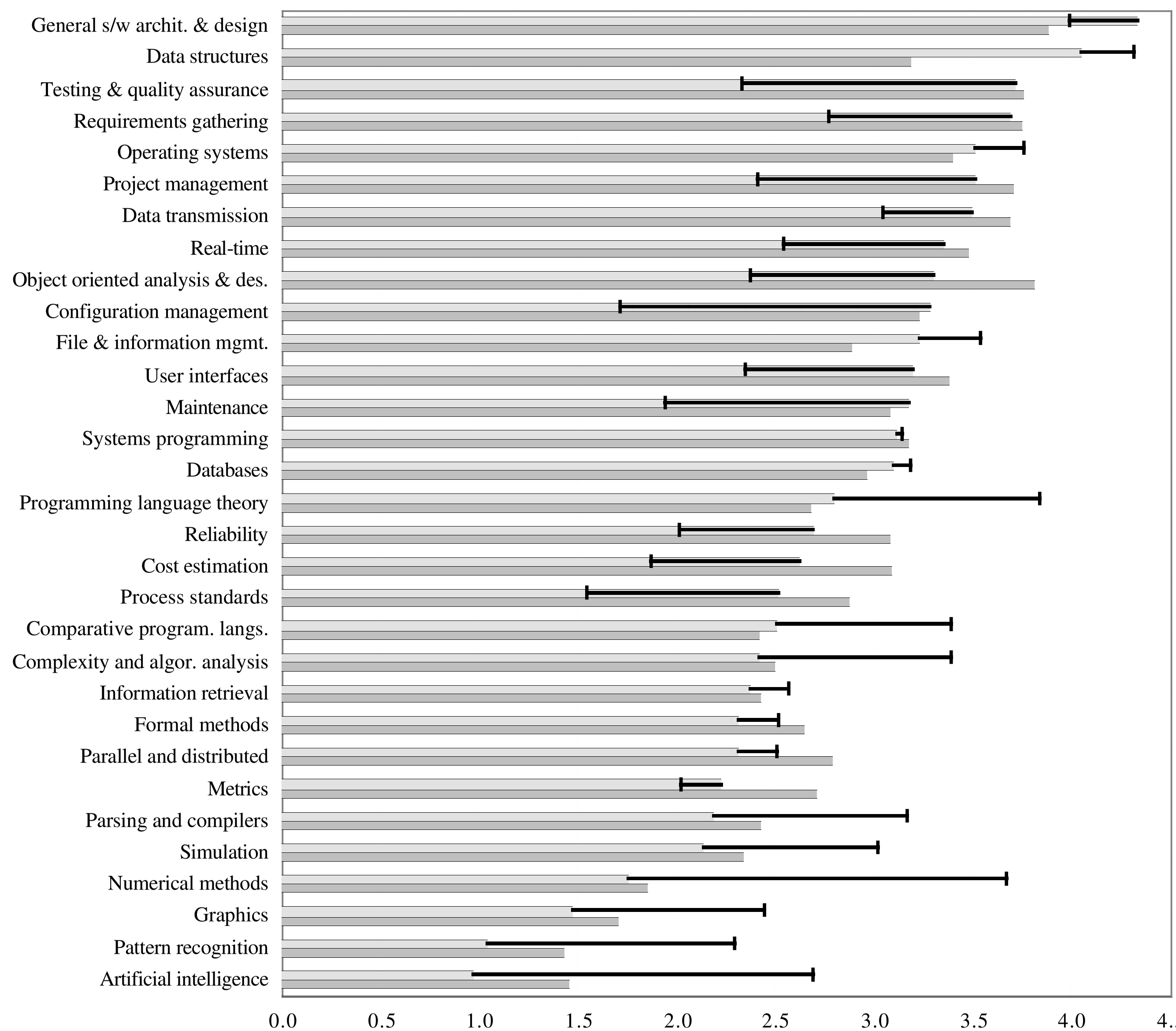
Question 1 uncorrelated with others (0.25)

- **How much learned in university**

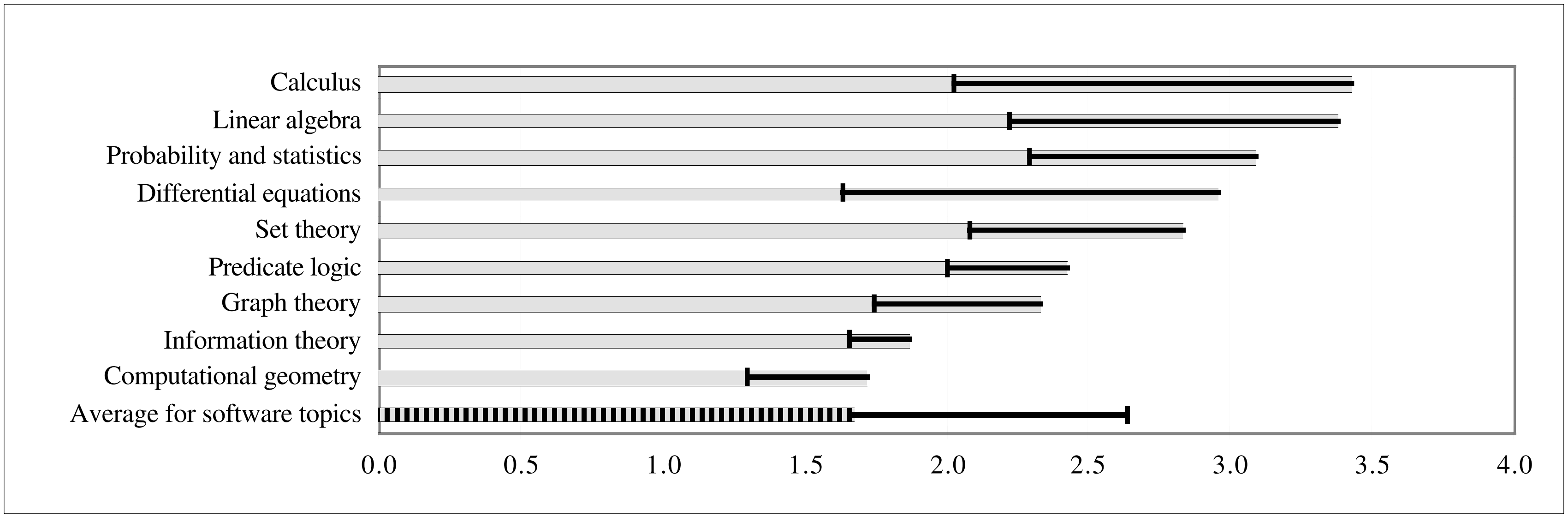
Software – What Was Learned?



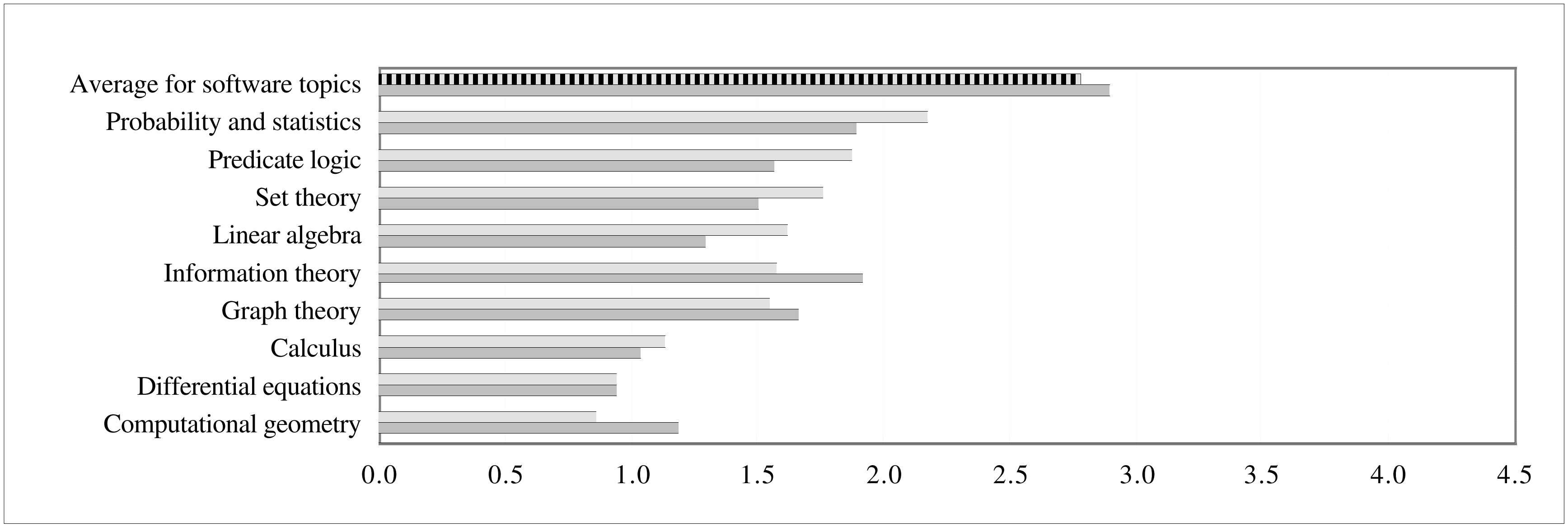
Software – How Important?



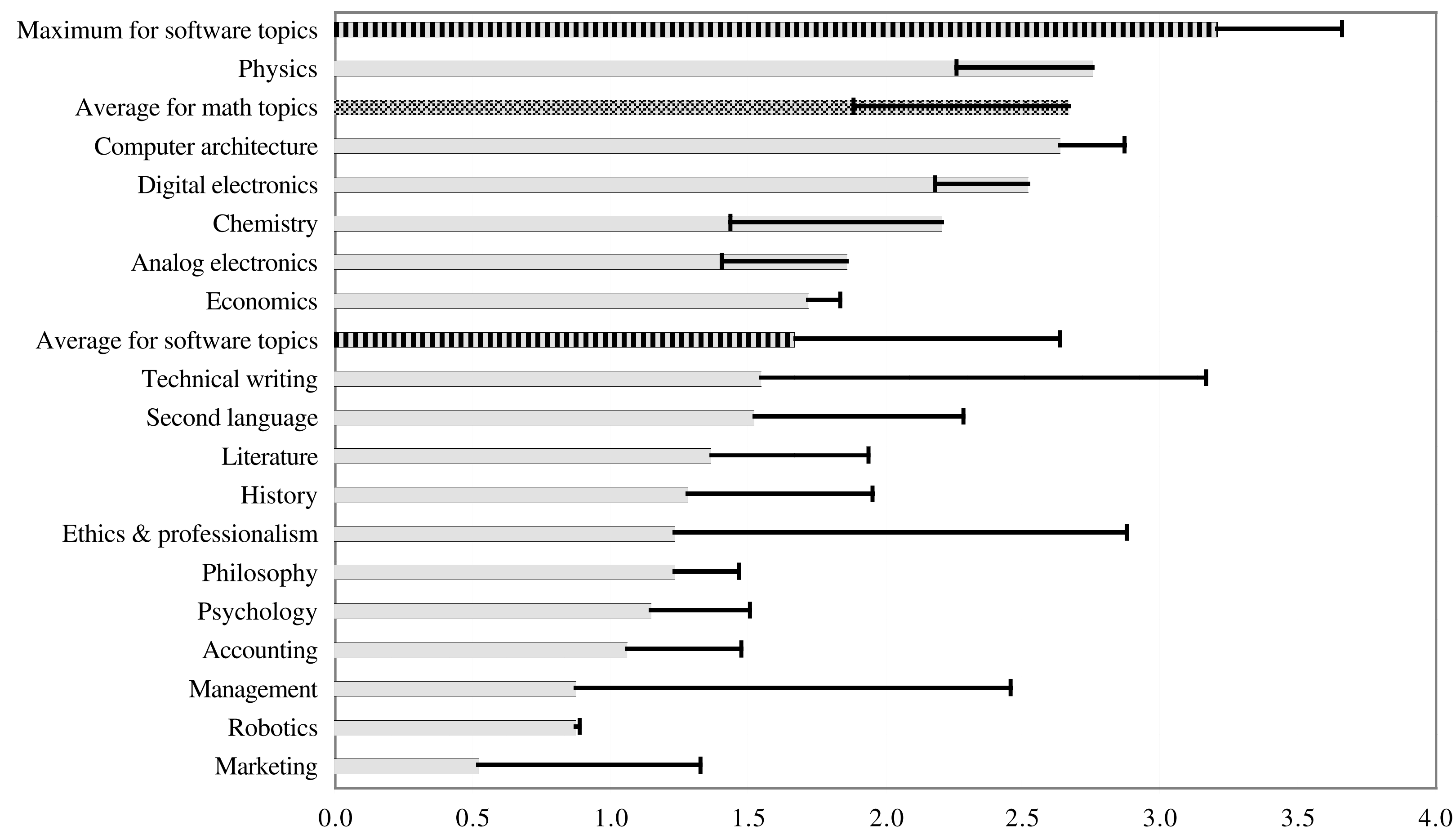
Math – What Was Learned?



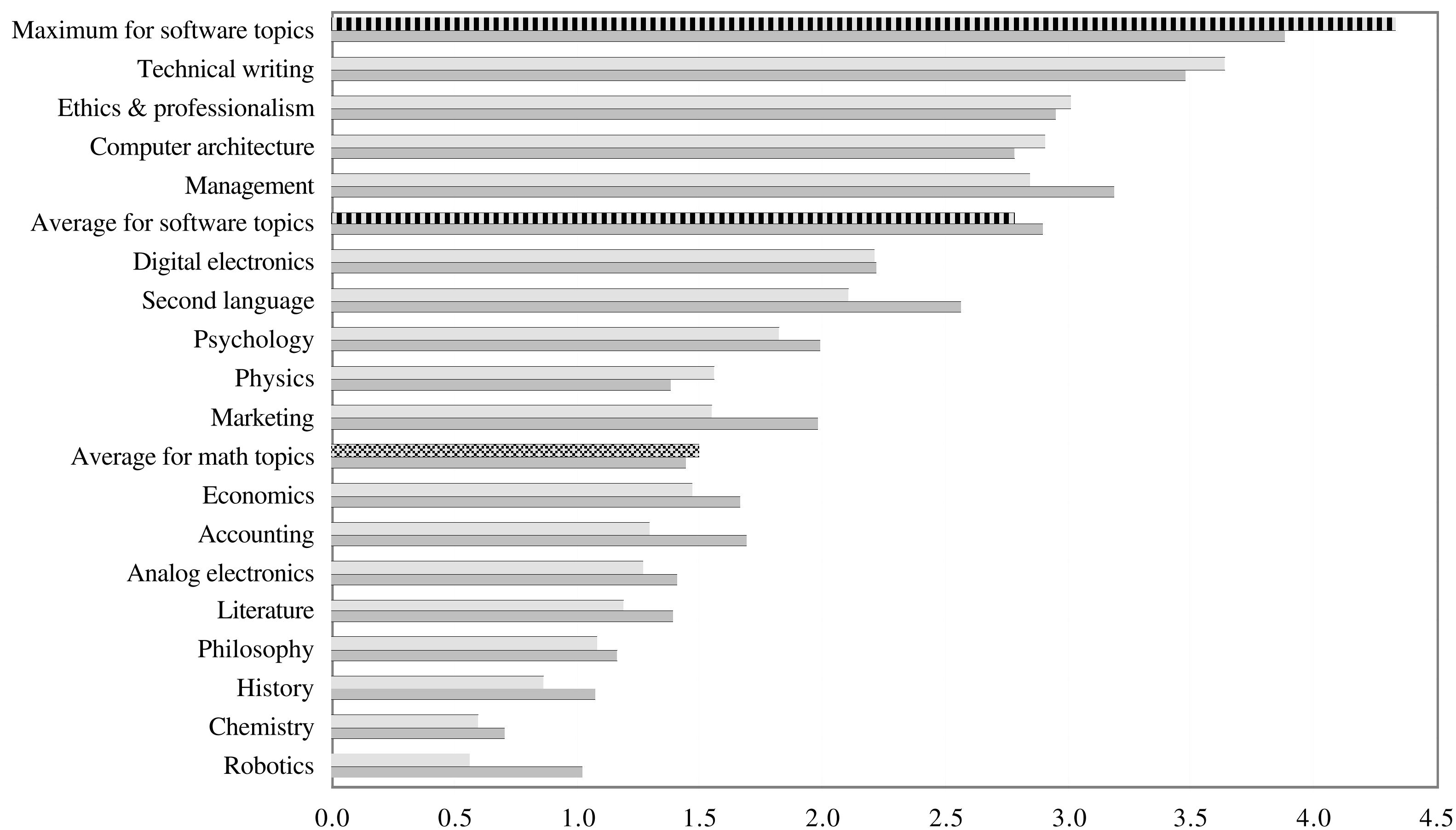
Math – How Important?



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: <u>65%</u>** **Canada: 49%**
- **CS / SE: <u>70%</u>** **Computer/Electrical Engg: 30%**
- **Junior: 43%** **Expert: <u>56%</u>**

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 transmision	Reengineering	Cost Estimation	Psychology	Marketing	Economics	Accounting
Learning required in work force	x	x	x	x	x	x										
Practitionners 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