

Computational Thinking An Overview

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Computational Thinking

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The Science of Computing

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& Francis

Contents of this talk

Why?
What?
How?
So what?

WHY?

1. Science has come to depend on computing

I) New tools for science

II) New scientific methods

Theory

Experiment

Computing

**III) New epistemology:
Limits of computing = limits of knowledge**

**IV) New epistemology:
Probably approximately correct**

GLOBAL WARMING: MODEL 1

GLOBAL WARMING: MODEL 2

V) New ways of collaborating

VI) New ontology



Bioinformatics

OUR "GENETIC CODE"

Computational physics

Digital humanities

Learning analytics

2. Digitalization of society



DIGITALIZATION OF PROCESSES

INTUITIVE INTERFACES

SENSOR TECHNOLOGY

DATA DELUGE

COMMUNICATION NETWORKS

COMMUNICATION NETWORKS

**3. Transformation of
routine jobs**



RETAIL

FAST FOOD

RENTAL SERVICES

BANKING

HOTELS

WAREHOUSING

**4. Transformation of
knowledge work**



ACCOUNTING

DESIGN

CUSTOMER SERVICE

JOURNALISM

COMPANY ANNUAL REPORTS

TRANSPORTATION

**NOW
WE HAVE:**

- NEW MEANS OF KNOWLEDGE PRODUCTION
- NEW EPISTEMOLOGY OF SCIENCE
- RAPID DIGITALIZATION OF SOCIETAL STRUCTURES AND PROCESSES
- NEW WAYS OF AUTOMATING KNOWLEDGE WORK

**A
COMPUTATIONAL
THINKING**

WHAT?

**COMPUTATIONAL
THINKING**

- * ABILITY TO SEE THE WORLD AS INFORMATION FLOWS
- * SKILLS TO MAKE COMPUTERS DO JOBS FOR US
- * ABILITY TO DESIGN FOR PEOPLE, WITH PEOPLE

Algorithmizing	1959
Algorithmic thinking	1972
Procedural thinking	1976
Procedural literacy	1980
Computational literacy	2000
Computational thinking	1980

HOW DO WE TEACH CT TO CHILDREN

LAVISH FUNDING

JOURNAL SPECIAL ISSUES

RESEARCH CENTERS

STEM CURRICULUM ELEMENTS

HOW?

**MODELING AND
EXPERIMENTING**

**CREATING
VISUAL
PROGRAMS**

**USING
COMPUTING IN
OTHER
SUBJECTS**

**BUILDING AND
CONTROLLING
MACHINERY**

**PLAYING
PUZZLE GAMES**

**PLAYING
GAMES
WITHOUT A
COMPUTER**

**VISUAL
PROGRAMMING**

**DESIGNING
SYSTEMS FOR
HUMANS**

**CREATING AND
MAKING
E-TEXTILES**

**TEACHING MACHINE LEARNING
SYSTEMS**

TEACHING IMAGE RECOGNITION

SOME CHALLENGES OF

CHALLENGE 1: “CODING” IS LOW AMBITION

- EPISTEMOLOGICAL REVOLUTION
- PEDAGOGICAL REVOLUTION
- SCIENTIFIC REVOLUTION

CHALLENGE 2: DOGMATISM VS. PLURALISM

- AVOID “COMPUTATIONAL CHAUVINISM”
- INVOLVE MORE FIELDS IN IT!

CHALLENGE 3: ROLE OF PROGRAMMING

Computational thinking



Programming skill

CHALLENGE 3: ROLE OF PROGRAMMING

Programming practice



Computational thinking

CHALLENGE 4: BUILD AN EVIDENCE BASE

- TEST CLAIMS BEFORE OVERSELLING CT

CHALLENGE 5: WHAT TO TEACH, HOW, AND AT WHAT AGE?

CHALLENGE 6: WHAT TO TEST AND HOW

COMPETENCES
KNOWLEDGE OF CONCEPTS
COMMUNICATION OF IDEAS
DESIGN SKILLS
ETC.

**CHALLENGE 7:
TRAINING THE
TEACHERS**

**CHALLENGE 8:
RENEWING WITH
THE FIELD**

- COMMODIFICATION OF MACHINE LEARNING
- AUTOMATION OF CODING
- THE RISE OF DESIGN

HOW DO WE DEAL WITH THE OTHER

**TRACKING REVEALS EXACTLY WHAT
YOU DID LAST SUMMER**

**MODELING REVEALS WHAT YOU WILL
DO NEXT SUMMER**

**PROFILING REVEALS WHAT YOU TRIED
TO KEEP SECRET**

**EMOTION
FARMING IS
FOCUSED ON
HOW TO MAKE
YOU HAPPY, SAD,
AND ANGRY**

**ATTENTION
ENGINEERING
FOCUSES ON
HOW TO GET YOU
ADDICTED**

**BEHAVIOR ENGINEERING IS FOCUSED
ON HOW TO MAKE YOU DO SOMETHING**

**AUTHORSHIP IDENTIFICATION ENSURES
THERE'S NO ANONYMITY**

**THERE ARE 70
MILLION DATA
POINTS ON
CHILDREN BY
THE TIME THEY
TURN 13 YEARS
OLD.**

**WHAT KIND
OF
COMPUTING**

Questions, comments?

Thanks!

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