Computing Curriculum 2020: A Global Initiative

Alison Clear

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Alison Clear

- Associate Professor at Eastern Institute of Technology, Auckland campus
- Fellow ITPNZ
- Fellow CITRENZ
- Over 40 years of teaching computing
- Previous Vice chair and Board member of SIGCSE
- Co-Chair CC2020

Introduction – New Zealand

New Zealand

New Zealand - India

CC2020 – What is it?

A multi-organizational global project to build on CC2005, consolidate all new curricular reports and produce futuristic tools for educators, students and employers

CC2020 Aim

To produce a modern replacement for the

CC2005 Computing Curricula Document

by the end of 2020

Sponsors

- ACM
- IEEE – Computer Society
  - AITP-EDSIG
  - AIS
  - SIGCHI

CC2020 Task Force Structure

Steering Committee

- A subset of the task force, currently, 13 people
- Does overall visioning and planning for the group
- Two co-chairs (ACM and IEEE Computer Society)

Task Force:

- Currently 36 people, representing 16 countries, from 6 continents
- Members handle much of the ongoing activities

Additional Participants

- Contributors
- Reviewers

Steering Committee Members

Steering Committee Members	Sponsor
Alison Clear (New Zealand)	ACM
Allen Parrish [USA]	IEEE
Ernesto Cuadros-Vargas [Peru]	IEEE
Stephen Frezza [USA]	IEEE
John Impagliazzo [USA]	ACM
Heikki Topi [USA]	AIS
Gerrit van der Veer [Netherlands]	SIGCHI
Abhijat Vichare [India]	ACM
Arnold Pears [Sweden]	IEEE
Shingo Takada [Japan]	ACM
Les Waguespack [USA]	AITP-EDSIG
Pearl Wang [USA]	IEEE
Ming Zhang [China]	ACM

Full Task Force Members

Alison Clear (NZ)	Allen Parrish (US)	Hala Alrumaih (Saudi Arabia)	Olga Bogoyavlenskaya (Rus)
Ernesto Cuadros-Vargas (Peru)	Adrienne Decker (US)	Eric Durant (US)	Marisa Exter (US)
Stephen Frezza (US)	Paul Leidig (US)	Stephen Gordon (US)	Jane Yung (China)
Eiji Hayashiguchi (Japan)	John Impagliazzo (US)	Richard LeBlanc (US)	Barry Lunt (US)
Tania McVeety (US)	Bruce McMillin (US)	Linda Marshall (South Africa)	Nancy Mead (US)
Mirella Moro (Brazil)	Arnold Pears (Sweden)	Teresa Pereira Bernadino (Portugal)	Melinda Reno (US)
Ariel Sabiguero (Uruguay)	Simon (Australia)	Shingo Takada (Japan)	Heikki Topi (US)
Paul Tyman (US)	Gerrit van der Veer (Netherlands)	Abhijat Vichare (India)	Barbara Viola (US)
Les Waguespack (US)	Pearl Wang (US)	Ming Zhang (China)	Stu Zweben (US)

Scope

- A three year project
- Not just a rewrite of CC2005
- A document that can be used by all areas of computing
- A document that can be used globally
- A “futuristic” document
- International collaboration

COMPUTING


Information Technology
Data Science
Information Systems
Cyber Security
Software Engineering
Computer Science
Computer Engineering
Artificial Intelligence

Degree Names

- Bachelor of
  - Science
  - Computer Science
  - Computer and Information Sciences
  - Information Systems
  - Information Technology
  - Computer Science and Technology
  - Technology
    - And many thousands more

What do we call the field/industry/profession

Information and Communications Technology

Information Technology

Computer Science

Hi-Tech

Computer Systems

Google!

Software Industry

CC2020 Activities

Adopted the word “Computing” as a unifying term

Adopted “Competency” to represent the future of all computing reports *Competency = Knowledge + Technical Skill + Human Disposition* to become the foundation for those reports

Develop modern visualizations to represent computing competency

Generate interactive computing tools useful for academia and industry

What is CC2005?

CC2005 = Computing Curricula 2005

Defined the computing disciplines at the baccalaureate level

Illustrated the knowledge scope of five computing disciplines

Provided comparison tables contrasting the five disciplines

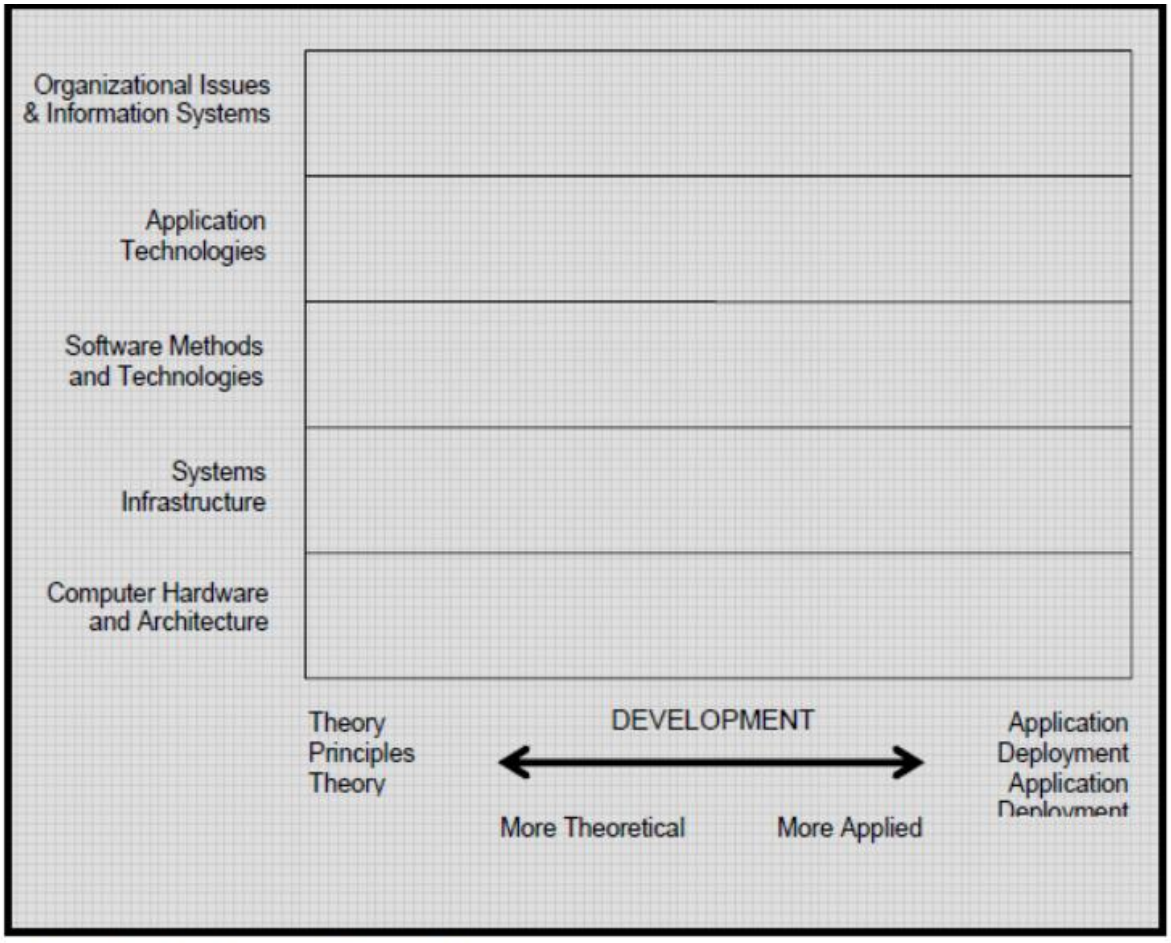
CC2005 Areas of Computing

- Computer Engineering
- Computer Science
- Software Engineering
- Information Systems
- Information Technology

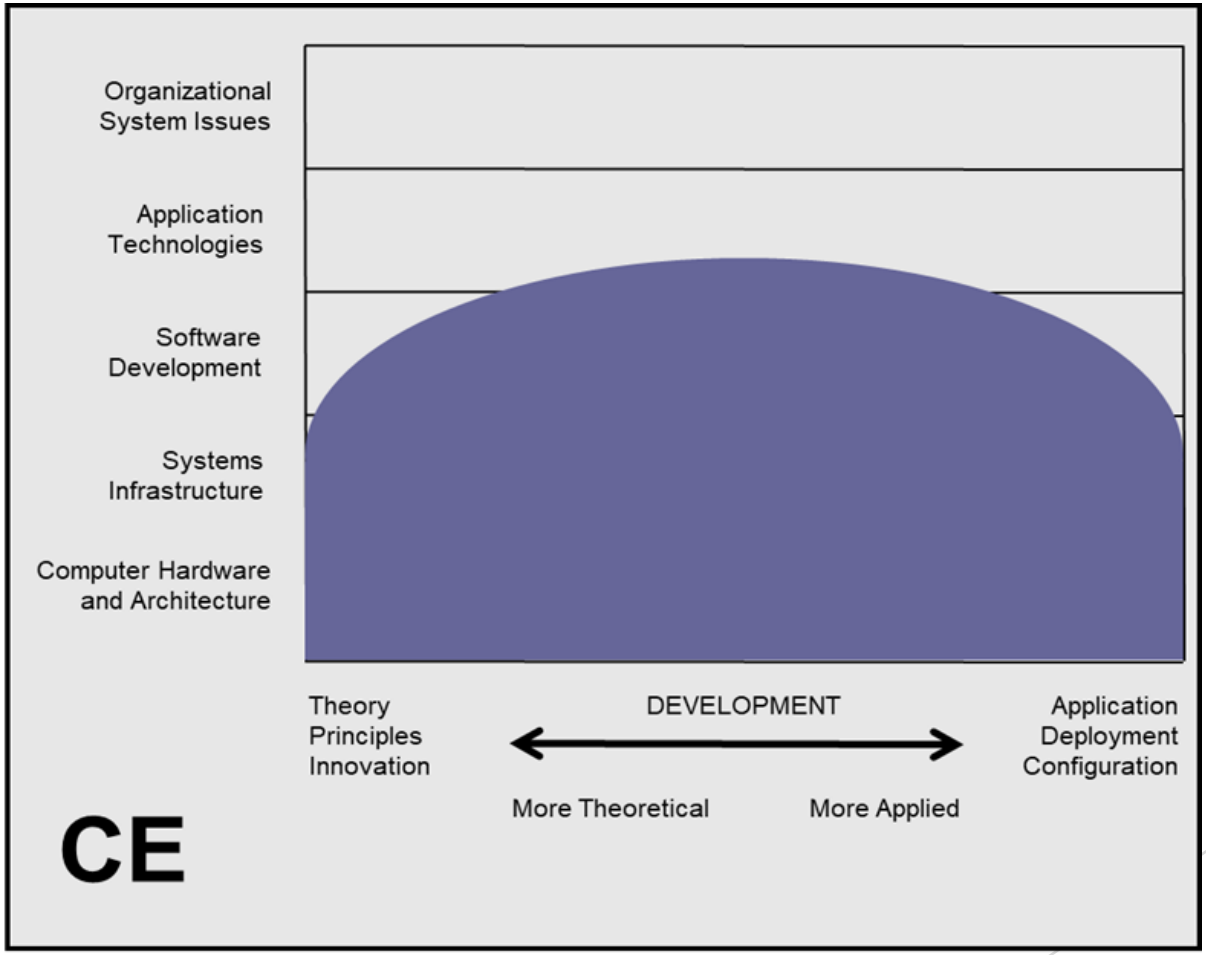
ACM Curriculum Documents

- IS2010
- CS2013
- SE2014
- CE2016
- IT2017
- Cyber Security
- Data Science (in development)

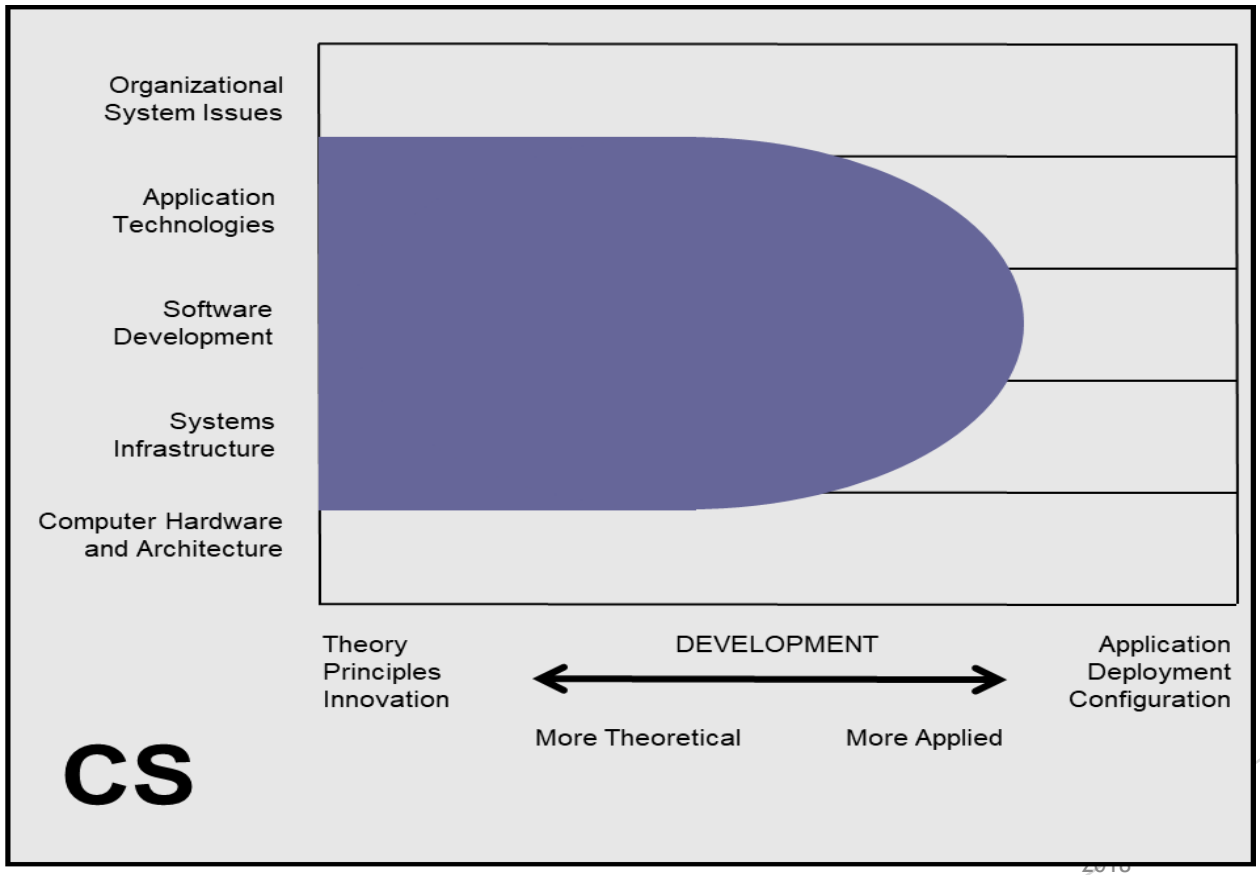
Visualization from CC2005



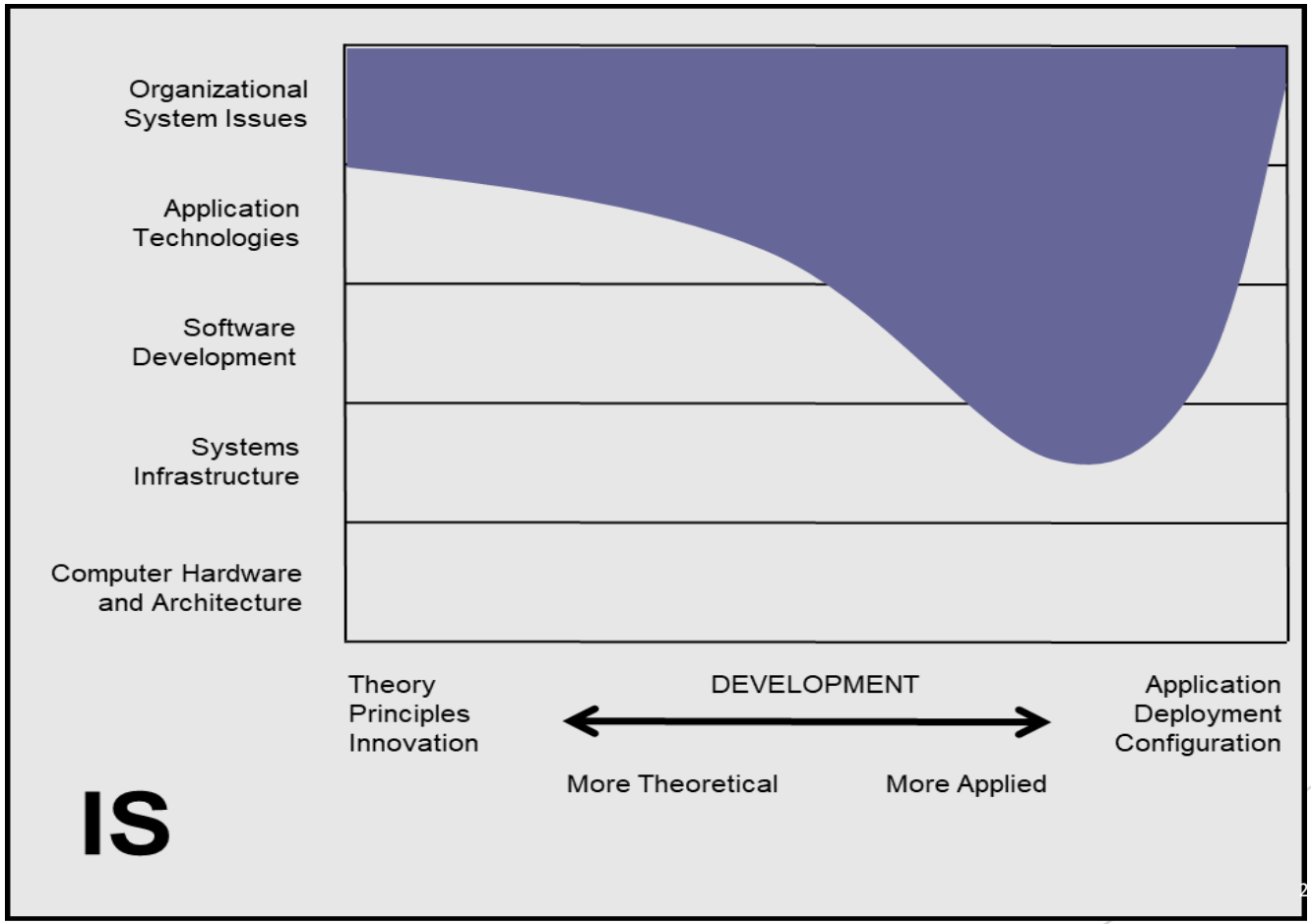
Visualization from CC2005 Computer Engineering



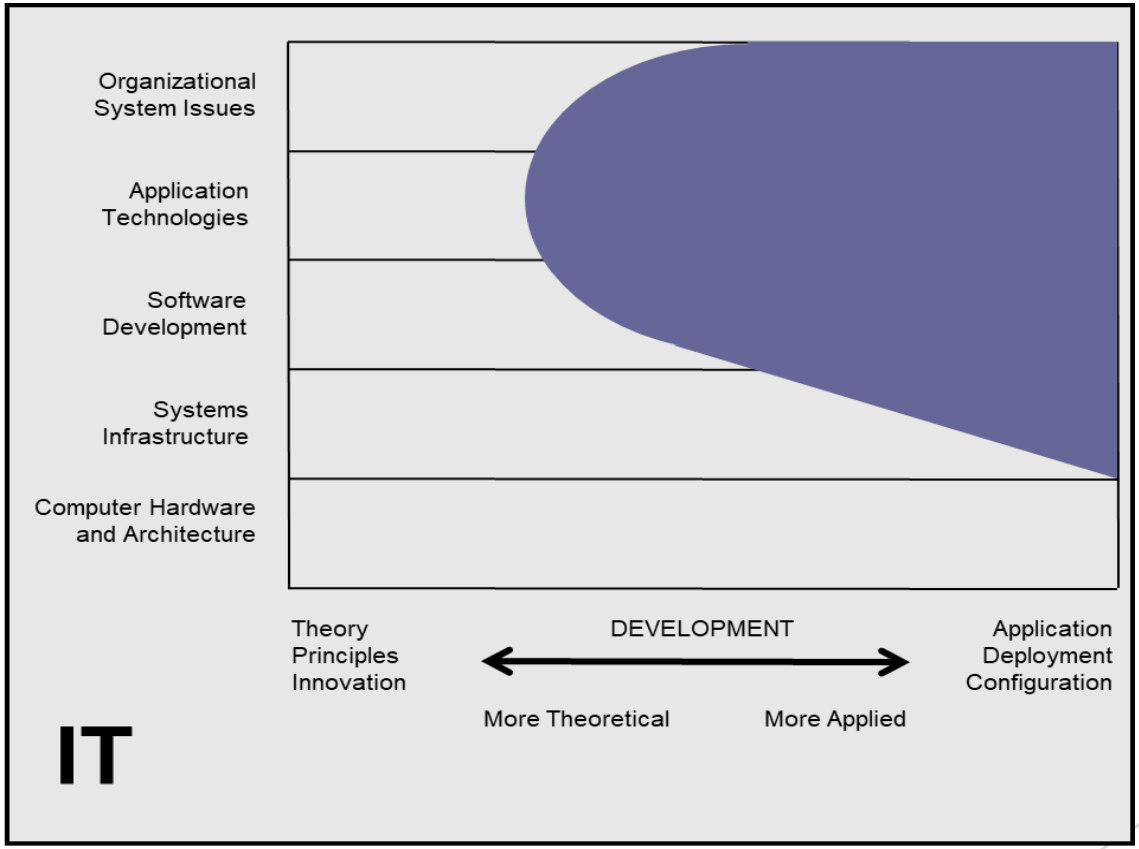
Visualization from CC2005 Computer Science



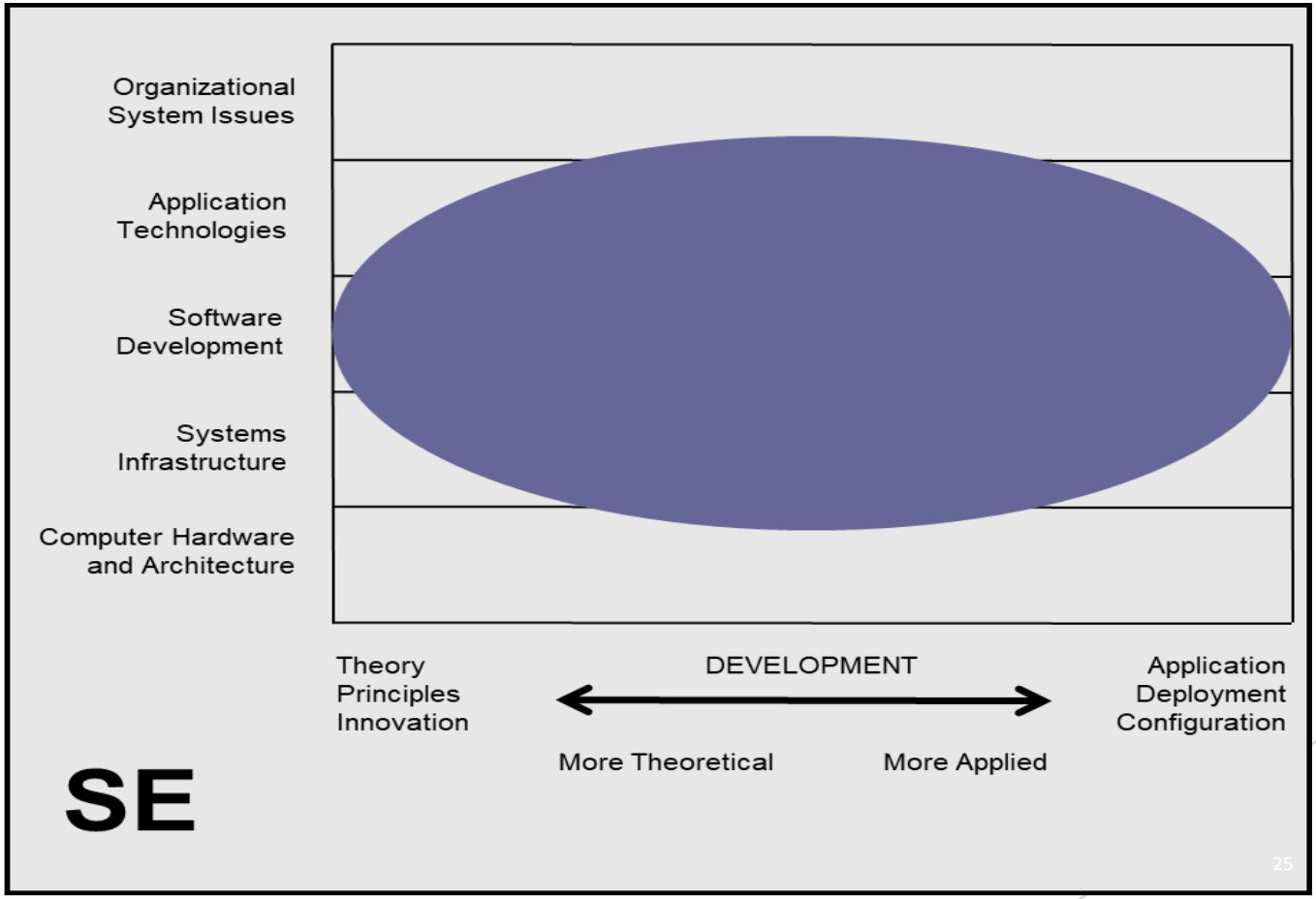
Visualization from CC2005 Information Systems [3 of 4]



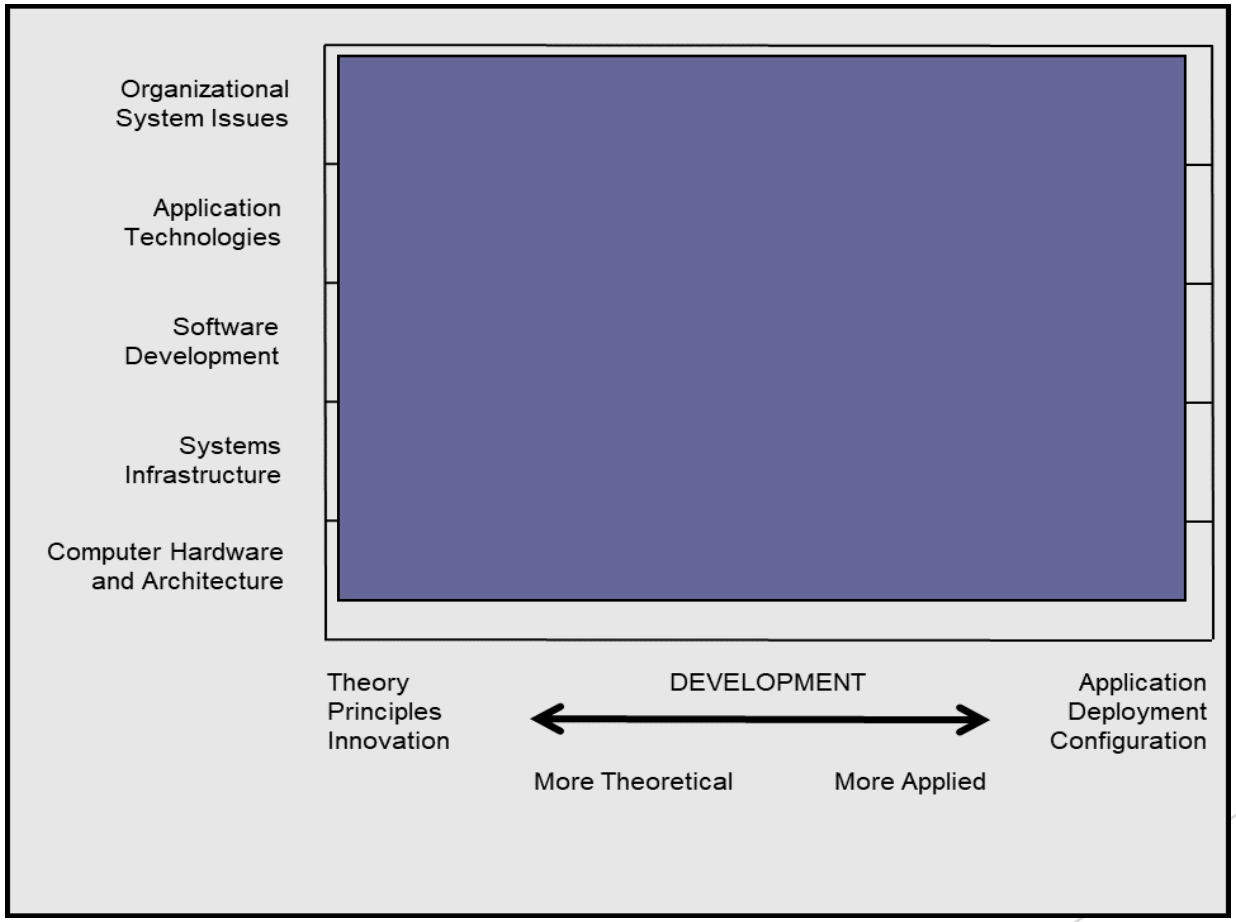
Visualization from CC2005 Information Technology



Visualization from CC2005 Software Engineering



Visualization from CC2005 All Computing



Accords: Washington & Seoul

- Washington Accord- Requires countries to create a body to develop accreditation NBA
- Seoul Accord – countries accredit programs under the criteria of the accord. All signatories agree to accredit programs according to the set criteria
- My own institution accreditation

- ABET – used CC2005 to develop criteria

- CC2020 will be able to be used by accreditation bodies to develop accreditation criteria

CC2020 Deliverables

- Report in two parts
  - How all the areas of computing/curricular documents work together now and in the future
  - The future of computing education
- Interactive “heat map” website
  - All knowledge areas, data driven, based on competencies
  - Ability to “map” your own degree programs
  - “example” degree programs from each area

Data Collection to date..

- 2017 Survey 2000+ replies
- Dissemination at
  - FIE (USA)
  - SIGCSE (USA)
  - ITiCSE (Europe)
  - EDUCON (Spain)
  - EDUNINE (South America)
  - ACE (Australasia)
  - TURC (China)
  - Computing Education Futures (China)
  - FIE (San Jose, USA)
- Meetings planned for
  - Lima, Peru and Latin America, October 2018
  - Chengdu, China, May 2019
  - Goa, India, October 2019

Global Implications

1. CC2020 should have a far-reaching and global effect on computing programs worldwide

2. Nomenclature varies globally and even within countries
   a. Universities better able to design their curriculum benchmarking other institutions

3. Countries wishing to be part of change can become increasingly involved
   a. Earlier curricular reports were mostly U.S.-centric efforts
   b. Professional societies from non-English speaking countries can translate documents into their local languages
   c. Sixteen countries already part of the CC2020 project

Competencies

Competency = Knowledge
+ Skill
+ Disposition
in Context

Competency = Knowledge + Skill + Ability

Competency = Knowledge + Skill + Behavior

Competency = Knowledge + Skill + Human Attributes

Past and Current Situation

Body of Knowledge

The complete set of concepts, terms and activities that make up a professional domain, as defined by the relevant professional association

It is more than simply a collection of terms … or a collection of information.

It is the accepted ontology for a specific domain.

[Institute for Competitive Intelligence]

Learning Outcomes

Learning outcomes are written statements of what a learner is expected to know and be able to demonstrate at the end of a learning unit (or cohesive set of units, course module, entire course, or full program)

[IT2017 Report]

Competency

Information Systems

Competencies represent a dynamic combination of cognitive and meta-cognitive skills, demonstration of knowledge and understanding, interpersonal, intellectual and practical skills, and ethical values.

[MSIS2016 Report]

Software Engineering

[Competency is the] demonstrated ability to perform work activities at a stated competency level, which is one of five increasing levels of ability to perform an activity …

[SWE Competency Model – 2014]

Competency

Information Technology [a]

Competence refers to the *performance* standards associated with a profession or membership to a licensing organization.

[IT2017 Report]

Information Technology [b]

Assessing some *level of performance* in the workplace is frequently used as a competence measure, which means measuring aspects of the job at which a person is competent.

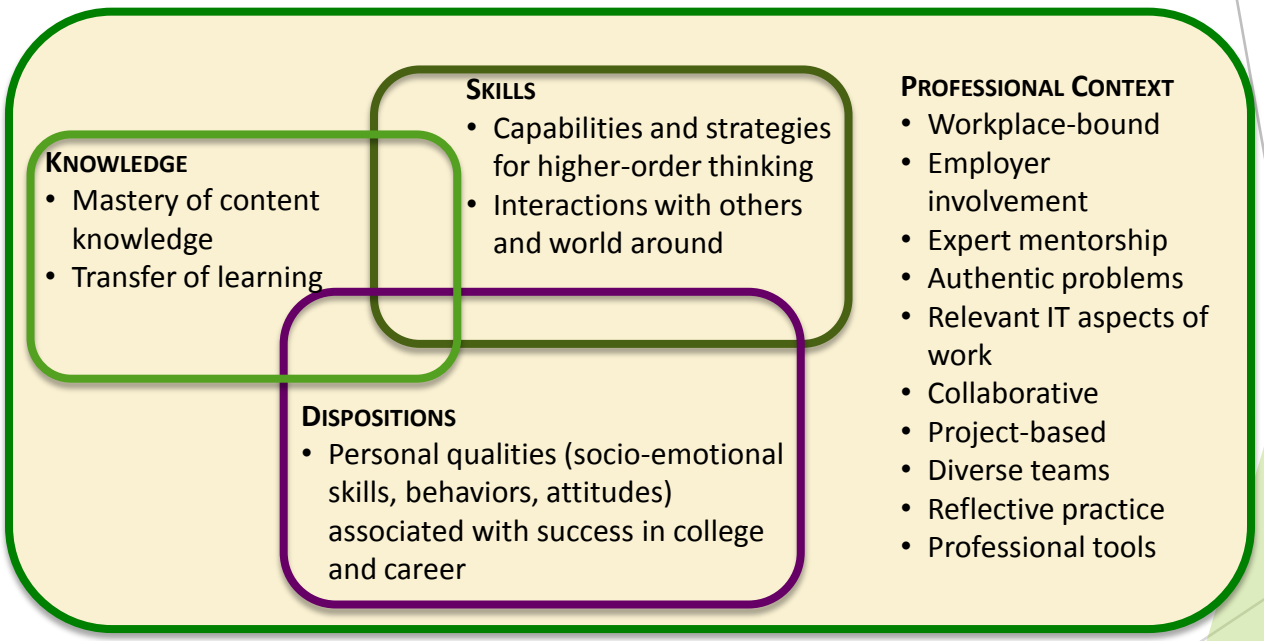
[IT2017 Report]

Disposition

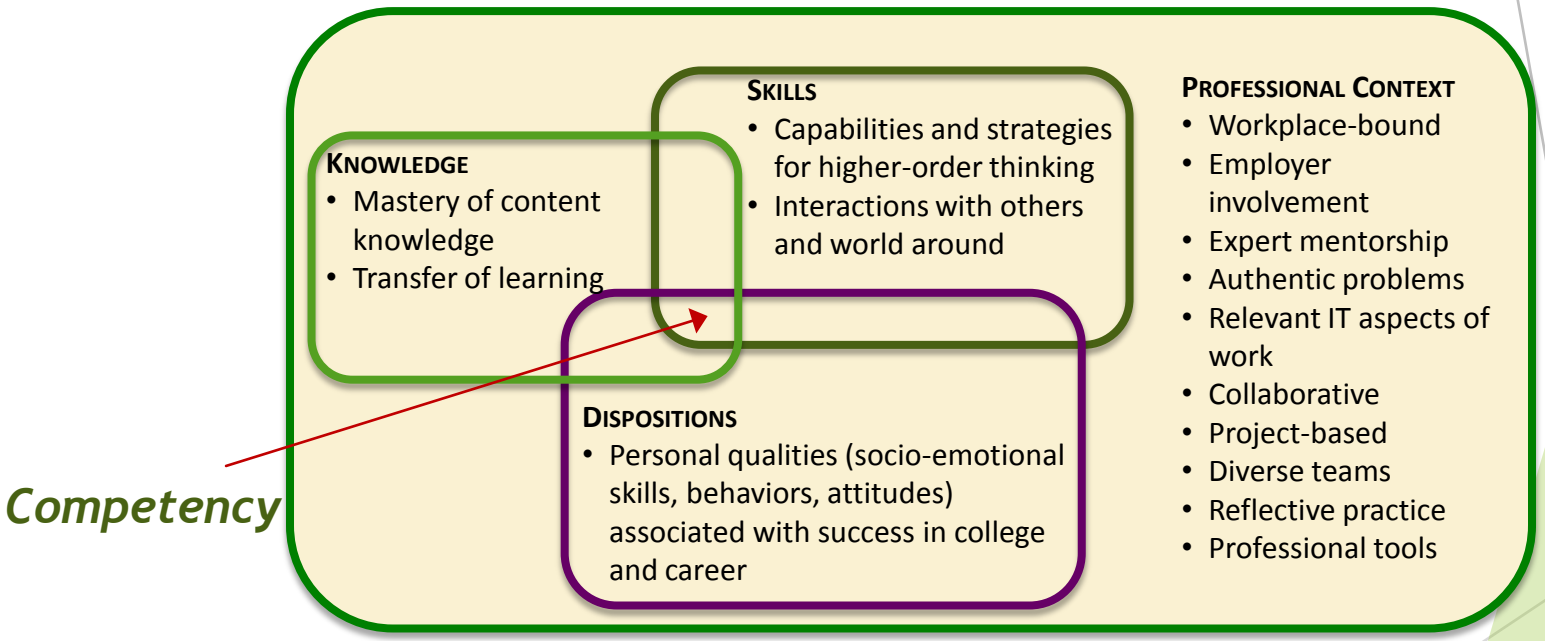
The affective component that deploys skill and knowledge into appropriate action in a specific context.

- Enacted Values
- Reflected through choices
- Informed by one's character and community
- Learned, Learnable
- Application shift with one's understanding of the context/circumstances
- Attitude

Competencies in IT Context



Competencies in IT Context



Competencies – IT example

- **ITE-GPP Global Professional Practice**
- ITE-GPP-01 Perspectives and impact
  - a. Describe the nature of professionalism and its place in the field of information technology.
  - b. Contrast ethical and legal issues as related to information technology.
  - c. Describe how IT uses or benefits from social and professional issues.
- ITE-GPP-02 Professional issues and responsibilities
  - a. Contrast the professional context of information technology and computing and adherence to ethical codes of conduct.
  - b. Describe and critique several historical, professional, ethical, and legal aspects of computing.

Competencies – SE example

- **Software Requirements**
- Identify and document software requirements by applying a known requirements elicitation technique in work sessions with stakeholders, using facilitative skills, as a contributing member of a requirements team.
- Analyze software requirements for consistency, completeness, and feasibility, and recommend improved requirements documentation, as a contributing member of a requirements team.
- Specify software requirements using standard specification formats and languages that have been selected for the project, and be able to describe the requirements in an understandable way to non-experts such as end users, other stakeholders, or administrative managers, as a contributing member of a requirements team.
- Verify and validate the requirements using standard techniques, including inspection, modeling, prototyping, and test case development, as a contributing member of a requirements team.
- Follow process and product management procedures identified for the project, as a contributing member of the requirements engineering team.

Competencies – CE example

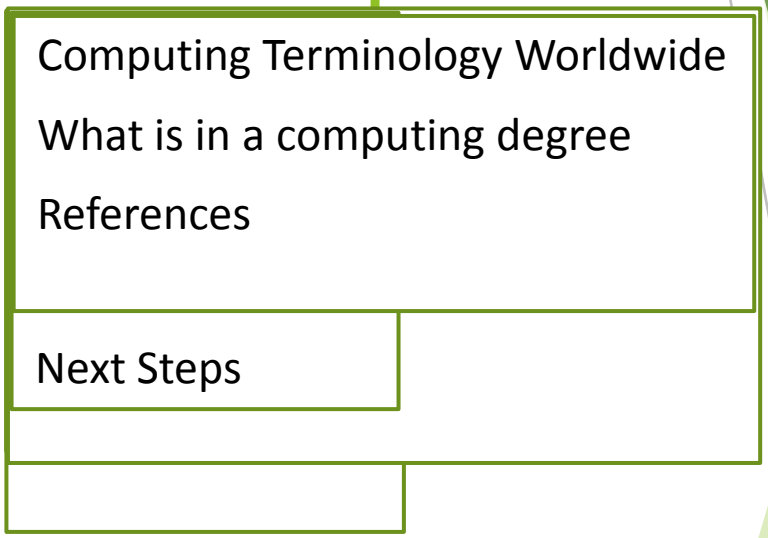
- CE-CAO
  - Manage the design of computer hardware components for a multidisciplinary research project and integrate such components to provide complete hardware systems which function reliably and efficiently demonstrating sensitivity for the context of the design envelope within which they were conceived. *[Measuring performance; Processor organization; Distributed systems architecture; Multi/Many-core architectures; Peripheral subsystems]*

Progress on Competencies

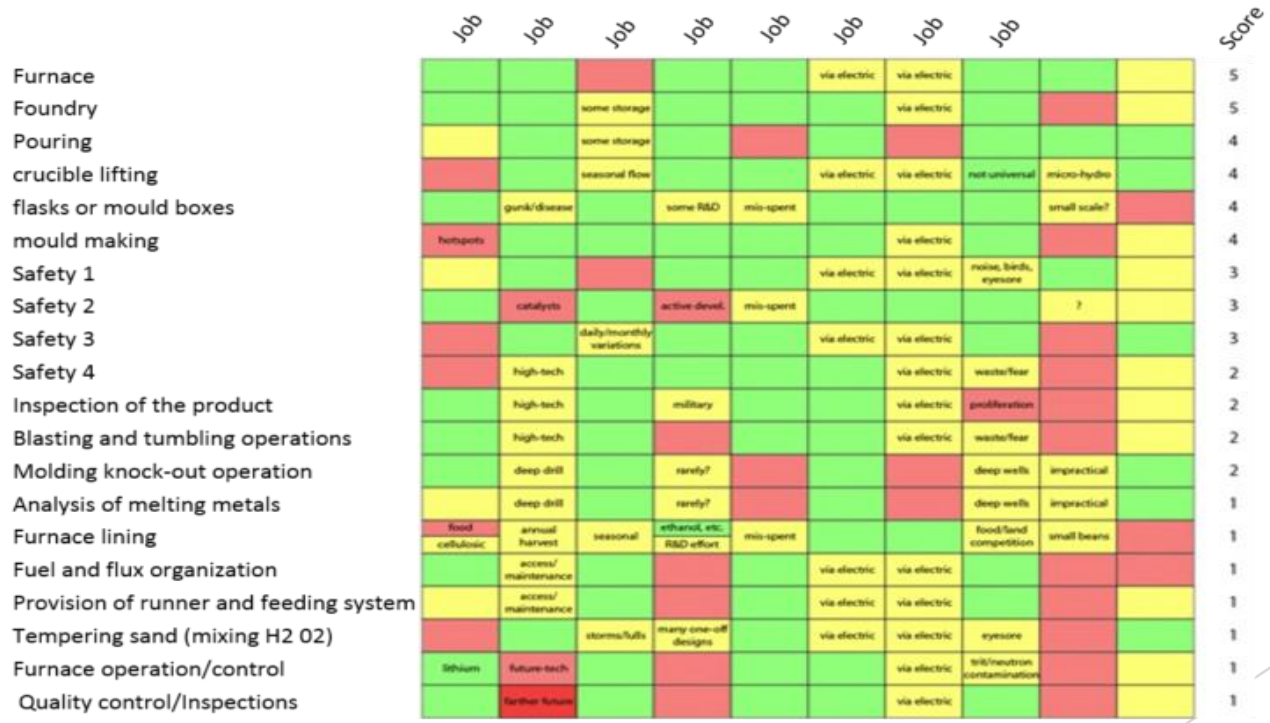
- Completed Competencies
  - Computer Engineering
  - Software Engineering
  - Information Technology
  - Computer Science
  - Information Systems
- New Competencies
  - Cyber Security in the new curricular document
  - Data Science under development

Overview of CC2020 Report

- Introduction
- Guiding Principles
- Landscape of Computing
- Computing Education
- Competency Modeling Tool
- Contextualizations
- Glossary
- Appendices



“Heat Map” Model



So what do our stakeholders want?

- Students a tool to understand the areas of computing
  a tool to choose the best degree for you
- Industry a tool to understand the breadth and depth of a future employees degree
  a tool to understand the areas of computing
- Government and Professional Bodies
  defining standards
  accreditation
- Faculty a document to help plan curricula and courses
  a document to benchmark globally
  A tool to help understand under graduate degrees

The “Heatmap” tool will help

- Compare and contrast baccalaureate programs
- Benchmark against other programs globally
- Show where on each axis the program fits
- Show employers the competency range of graduates
- Show potential students the academic range of each program

Progress to date

- Task Force Sub group completed the competencies
- Task Force sub group drafted first chapters of report
- Task Force sub group developing prototype of the visualisation tool
- Presentations
  - Workshops
  - Panels
  - Roundtables
  - Work-in-progress papers
  - Full papers

We welcome your input!

- We welcome feedback on interim products
- We welcome input on how best these products will help
  - Faulty design
  - Students learn
  - Industry employ
- We invite volunteers for subgroups

Conclusion CC2020

- A global effort to provide a global overview of computing curricular
- A futuristic document
- Collaboration between organisations
- Collaboration between education and industry
- We are very excited to produce useful tools that are
  - Global
  - Futuristic
  - Helpful

Thank you

New Zealand


Scandinavia
United Kingdom
Russia
Alaska
Canada
Central Europe
USA
Korea
Japan
China
Israel
Iran
Algeria
Libya
Egypt
Saudi Arabia
India
Taiwan
Hong Kong
Mexico
Hawaii
Sudan
United Arab Emirates
Philippines
Thailand
Malaysia
Singapore
Colombia
Indonesia
Peru
Brazil
Fiji
Australia
South Africa
Chile
Argentina
Tasmania
New Zealand
Antarctica

New Zealand


United Kingdom
Scandinavia
Russia
Alaska
Canada
Central Europe
USA
Korea
Japan
China
Israel
Iran
Algeria
Libya
Egypt
Saudi Arabia
India
Taiwan
Hong Kong
Mexico
Hawaii
Sudan
United Arab Emirates
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