Citation Key
for more information see: http://open.umich.edu/wiki/CitationPolicy

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.
- **Creative Commons – Zero Waiver**
- **Creative Commons – Attribution License**
- **Creative Commons – Attribution Share Alike License**
- **Creative Commons – Attribution Noncommercial License**
- **Creative Commons – Attribution Noncommercial Share Alike License**
- **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.
Key Elements & Functions of Information Systems

Motivation lecture in Course –
Introduction to Health Informatics
Fall 2013
Allen Flynn, PharmD
Graduate Student Instructor
Course Map-Week 6

Lectures

1. **EHRs (VistA)**
   - Elements & functions of Info. Systems

2. HIT STANDARDS

5 DOMAINS

10 METHODS

4 INFO. RESOURCES

DISCUSSION DAY

KICK OFF

END

Skill Modules

time
Upcoming Course Dates & Other News

• Last day Skill Module 1 full credit **today**
• Next meeting after fall break, Wed. 10/16
• *New Tutors’ Schedule Posted on Ctools*
• Paper/Essay 1 due October 16th, 3pm

~~~

• Materials for Skill Module 2 **now available**
• Open tutoring/testing October 23rd
• Last day Skill Module 2 = Oct 30th
Agenda for Today

• On Computation

• Types of Information Systems
  – Communication systems
  – Database systems
  – Advice-giving systems

• Types of Knowledge

• Data Modeling

• Data Privacy & Security

• Content & materials for Skill Module 2
Computation is...

*noun* “determining something by mathematical and/or logical methods”*

*Wordnet 3.0*
Computation is...

Numerical/Arithmetical
Mathematical ( + − × ÷ )

*interacting with*

Qualitative / Logical
Procedural
Bounded rationality.

“The meaning of rationality in situations where the complexity of the environment is immensely greater than the computational powers of the adaptive system”, Simon, The Sciences of the Artificial, p. 166
Human Limitations: Genomic Data and Decision Making

Decisions by clinical phenotype, i.e., traditional health care

Human Cognitive Capacity

Proteomics and other effector molecules

Functional Genetics: Gene expression profiles

Structural Genetics: e.g. SNPs, haplotypes

Slide courtesy of Bill Stead & Dan Masys

Facts per Decision

- 1000
- 100
- 10

1990 2000 2010 2020
Remember the Goal of Informatics

The “Fundamental Theorem”:*  

The “practice” of informatics is the pursuit of information and knowledge resources that seek to make people “better” than they would be if unassisted, and also to explore if they have been successful in that pursuit.

• On Computation

• Types of Information Systems
  – Communication systems
  – Database systems
  – Advice-giving systems

• Types of Knowledge

• Data Modeling

• Data Privacy & Security

• Content & materials for Skill Module 2
Information Systems

• A system is an organized set of parts and procedures for accomplishing a task
• A system is composed of elements (sub-systems) that work together to accomplish a task not achievable by any of the elements alone

• Information systems include:
  – Hardware (physical parts; “nuts and bolts”)
  – Software (coded instructions: “bits and bytes”)
  – People
  – Socio-cultural context(s)
Communication Systems

- Sender sends a message to a receiver
- Communication is successful if the receiver derives the same meaning and/or acts as the sender intended
- Complete communication usually includes a confirmation of receipt (send back from receiver to sender)
Health Information Exchange is...

(a) *Verb* “The electronic sharing of health-related information among organizations.”

For a similar definition to (a) above of HIE see: p. 17
Communication and Health Information Exchange

- The Challenge: Requires ‘micrometer precision’ in specifying syntax and semantics
  - Machines are “brittle” and unforgiving
- Syntax = The structure of the message
  
  |BEGINNING|What is Being Sent (a Finding)|Name of Finding|How Name Coded|Value|How Value Coded|END|

- Semantics: The meanings of the codes
Database Management Systems

- **Data** structured as: fields, records, and files
- **Transactions** change the value of data elements
  - Records of transactions are themselves a form of data
- **Data management functions:** enter, edit, browse, search, analyze, report
Advice-Giving System Architecture

Data
- Image
- Removed - Copyright

Reasoner

Knowledge

Human Decision-Maker

Trigger

Renderer
What is Advice?

**advice, n**, guidance or recommendations concerning prudent future action

from Google, Inc., 2013.
Key Ingredients of Successful Advice-Giving
(a.k.a., Clinical Decision Support or CDS)

- Go after the right problem
- Tell the user:
  - something correct or at least plausible
  - that he/she doesn’t already know
    (or cannot reasonably be expected to compute or recall)
- Conform to how:
  - the user thinks (thoughtflow)
  - the user works (workflow)
Advice-Giving System Architecture

Data
Image Removed - Copyright

Reasoner

Knowledge

Human Decision-Maker

Trigger

Renderer
Selected Alternatives for Representing Knowledge

- Rules
- Entities and relations among them
Representation as Rules

IF:

An order for a FLUOROSCOPY is received AND
The patient’s serum BUN level > 20 mg/dL AND
The patient’s serum CREATININE level is > 2.5 mg/dL,

THEN:

Send a message to the patient's physician indicating a possible adverse effect of fluoroscopy.
Representation as Entities & Relations

**ontology, n**, an exhaustive organization of some knowledge domain that contains all the relevant entities and their relations*

*Wordnet 3.0
Entities & Relations

INSTRUCTORS
- Teach/Are Taught by

STUDENTS
- Take/Are Available to
- Have been credited to students

COURSES
- Include/Are examples of
  - Undergrad. Courses
  - Graduate Courses
  - Required Courses

Completed Courses
- Get credit for 25
Advice-Giving System Architecture

- Data
- Image removed - copyright
- Reasoner
- Knowledge
- Human Decision-Maker
- Renderer
- Trigger
The Reasoner

• The working of the reasoner depends on the **knowledge representation model**

• **Rules:** Logic operations that determine whether the rule “fires” or not

• **Sets:** Feed patient data to the model and infer a categorization or implication
Can all knowledge be represented to make it computable by machines (IT)?
• On Computation
• Types of Information Systems
  – Communication systems
  – Database systems
  – Advice-giving systems
• Types of Knowledge
• Data Modeling
• Data Privacy & Security
• Content & materials for Skill Module 2
Exhibit 8.1: Types of Knowledge

Communication, representation, analysis

Explicit
- Documented: Data, text, and other information stored in files, reports, etc.
- Expressed: Information presented verbally or symbolically

Implicit
- Drive slower in icy conditions

Latent
- Solve novel problem: flat tires + wet road

Tacit
- Skilled performances, e.g., evasive maneuver

Reasoning, dialogue, learning

Knowledge Management

Note: *Latent and tacit knowledge when discovered are converted to explicit knowledge.

© 2012 Health Administration Press
• On Computation
• Types of Information Systems
  – Communication systems
  – Database systems
  – Advice-giving systems
• Types of Knowledge
• Data Modeling
• Data Privacy & Security
• Content & materials for Skill Module 2
Modeling

• A representation of a system that allows for investigation of the properties of the system and, in some cases, prediction of future outcomes.
• Models allow us to understand the dynamics of a system, and the consequences of changing a system without having to experiment on the system itself.
• Models are abstractions
• Models are never complete
  – A good model captures the key features
Exhibit 9.3: The Modeling Process

Real World

Model

Information

Paradigm

Action

Models are incomplete representations of the real world

© 2012 Health Administration Press
Important Types of Models

• Data models
  > includes entity-relationship models
• Decision models
• Information flow models
Data Model – Common Cold

- Onset
- Symptoms
- Remedies
- Individual
- Duration
- Recent Contacts
Information Flow Models

1. Schedule specimen collection
   - Staff work schedule
   - Laboratory test orders
   - Patient database

2. Analyze results
   - Previous results
   - New test results
   - Normal results
   - Abnormal results
   - Valid new results

3. Report results
   - Normal results
   - Abnormal results
   - Reports of laboratory test results

4. Perform quality assurance
   - Valid new results
   - Reports of quality assurance
• On Computation
• Types of Information Systems
  – Communication systems
  – Database systems
  – Advice-giving systems
• Types of Knowledge
• Data Modeling
• Data Privacy & Security
• Content & materials for Skill Module 2
Privacy and Confidentiality
Distinguished from Security

• **Privacy:** The desire of a person to control disclosure of personal health information

• **Confidentiality:** The ability of a person to control the release of his/her information

• **Security:** The protection of privacy and confidentiality through policies, procedures, and safeguards
Three Types of Data Security Safeguards

• **Physical**: Locked doors and locked cabinets
• **Technical**: Encryption, Password Authentication
• **Administrative**: Policies, e.g., defining minimum security standards for software used in an organization
Key Security Concepts: Authentication and Authorization

- **Authentication**: You are who you say you are.
- **Authorization**: What you are permitted, by policy, to do/see in an information environment
Authentication Factors

• Something you have – an ID badge
• Something you are – a fingerprint scan
• Something you know – a password

What is “two-factor” authentication?
What would “three-factor” authentication be?
Review

• What Computation is
• 3 Types of Information Systems
• 4 Types of Knowledge
• Modeling, incl. Data Modeling
• Data Privacy & Security, Safeguards, Authentication, and Authorization

• Content & materials for Skill Module 2
END
Image Attributions

- The image “Human Limitations: Genomic Data and Decision Making” is courtesy of Bill Stead & Dan Masys
- “Palette and brush” by ejmilian is in the Public Domain.
- “Netalloy gears” by netalloy is in the Public Domain.
- “Alarm clock” by Anonymous is in the Public Domain.
- “Books” by Johnny Automatic is in the Public Domain.
- “Brian diagram” by j4p4n is in the Public Domain.
- “Health Informatics: a Systems Perspective” by Health Administration Press is All Rights Reserved.
- “Tango computer” by warszawianka is in the Public Domain.
- “The Computer and the Brain” by Yale University Press is All Rights Reserved.
- “The Sciences of the Artificial” by the MIT Press is All Rights Reserved.
- “Phone” by tonyk is in the Public Domain.
- “Feverish woman” by Moini is in the Public Domain.
- “Therapist” by tulvur is in the Public Domain.