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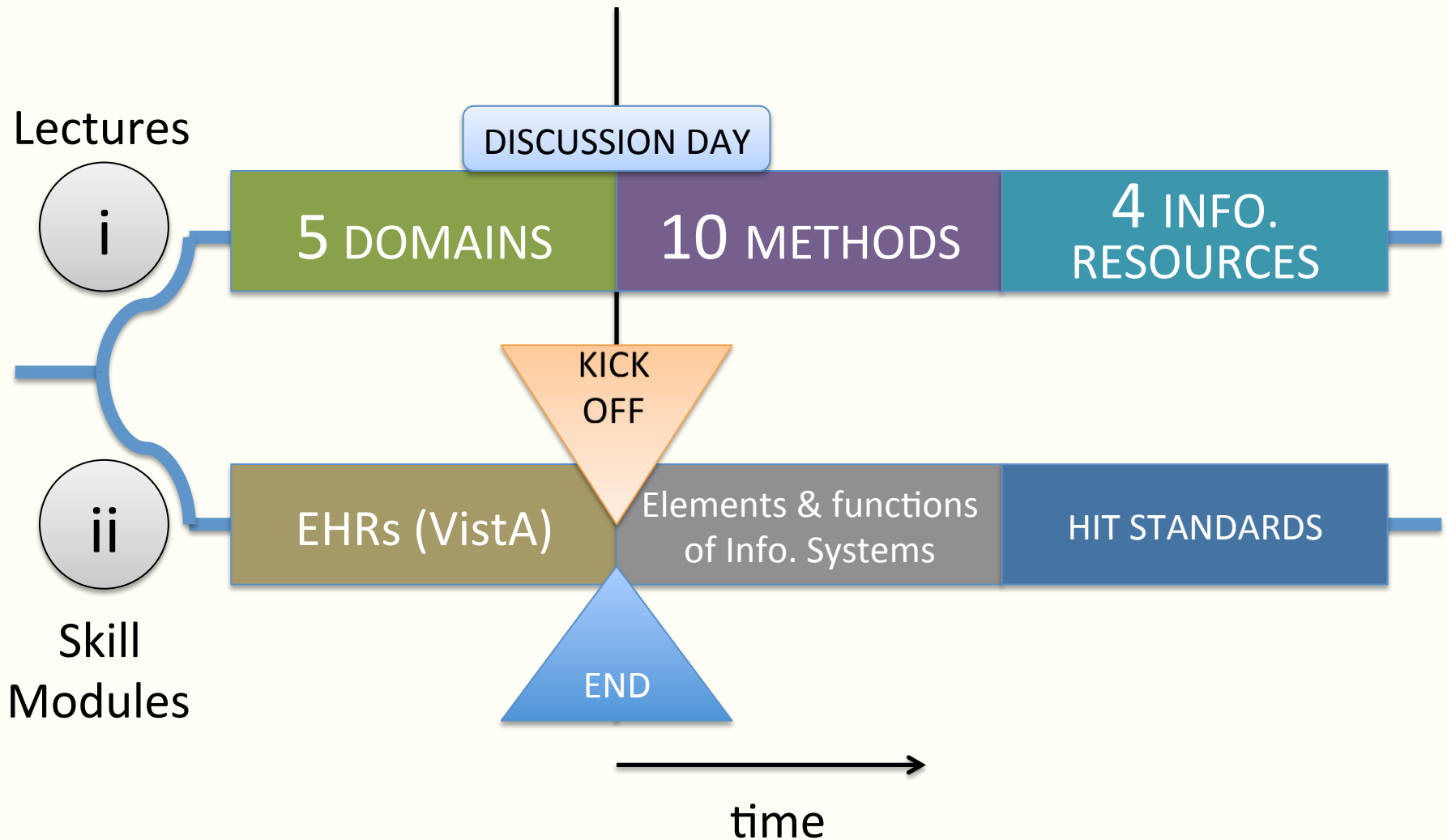
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Key Elements & Functions of Information Systems

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

Course Map-Week 6



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

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- Materials for Skill Module 2 **now available**
- Open tutoring/testing October 23<sup>rd</sup>
- 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

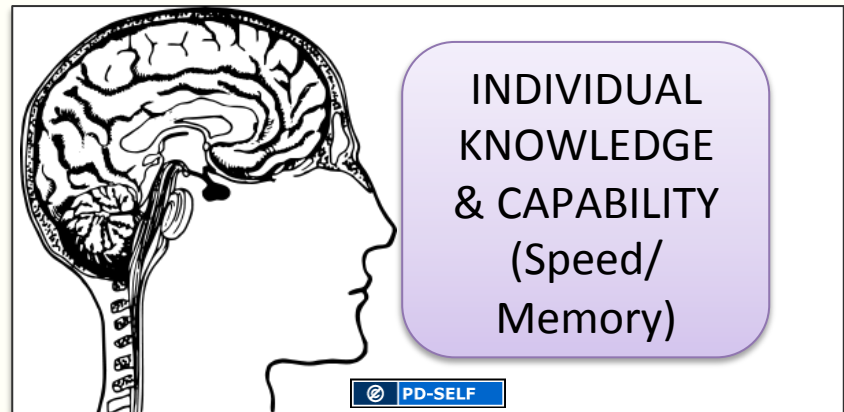


# Bounded rationality.

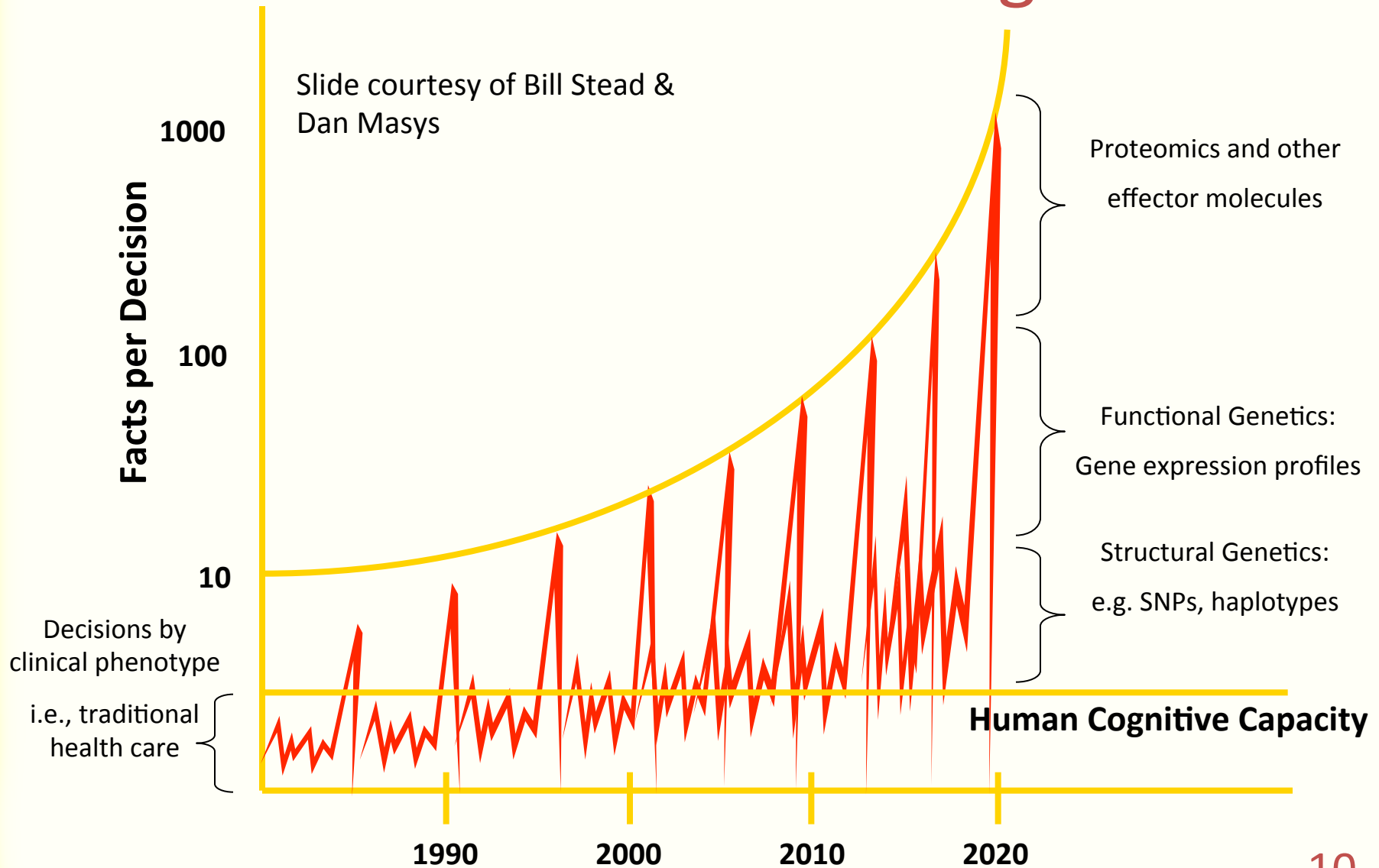
“The meaning of rationality in situations where the complexity of the environment is immensely greater than the computational powers of the adaptive system”, Simon, *The Sciences of the Artificial*, p. 166

INFORMATION

TIME

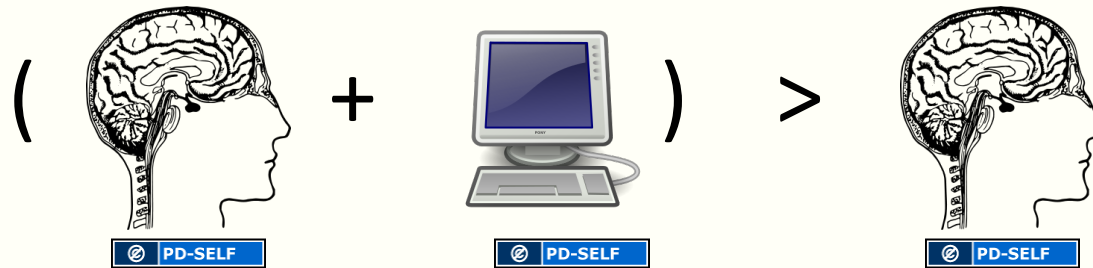


# Human Limitations: Genomic Data and Decision Making



# 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.*

\*Friedman CP. A ‘fundamental theorem’ of biomedical informatics. Journal of the American Medical Informatics Association, 16: 169-170, 2009.

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# 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



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- 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:

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# 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

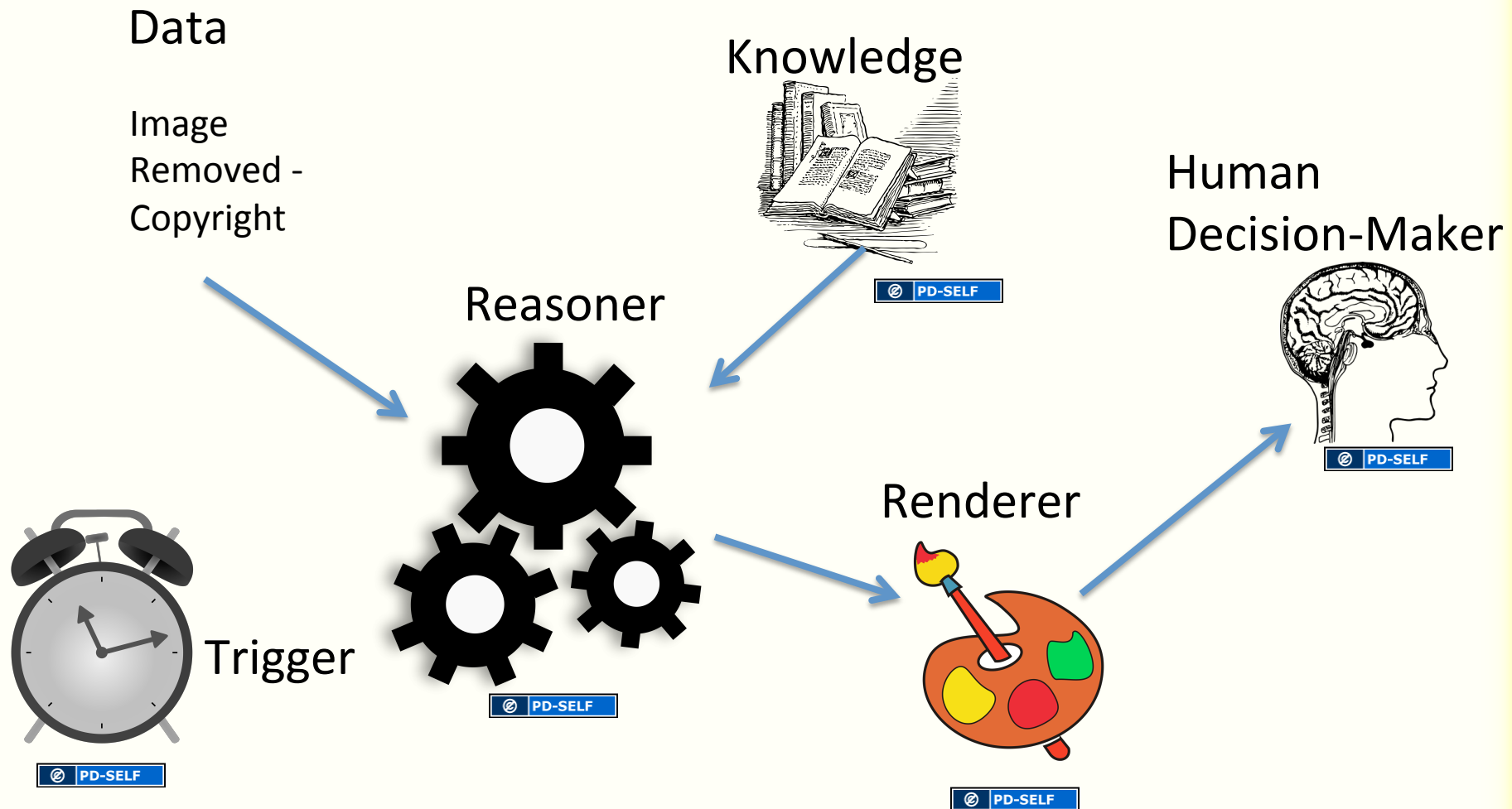
*/>>BEGINNING/What is Being Sent (a Finding)/  
Name of Finding/How Name Coded/Value/How  
Value Coded/END<</i>*
- Semantics: The meanings of the codes



# 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



# What is Advice?

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

from Google, Inc., 2013.

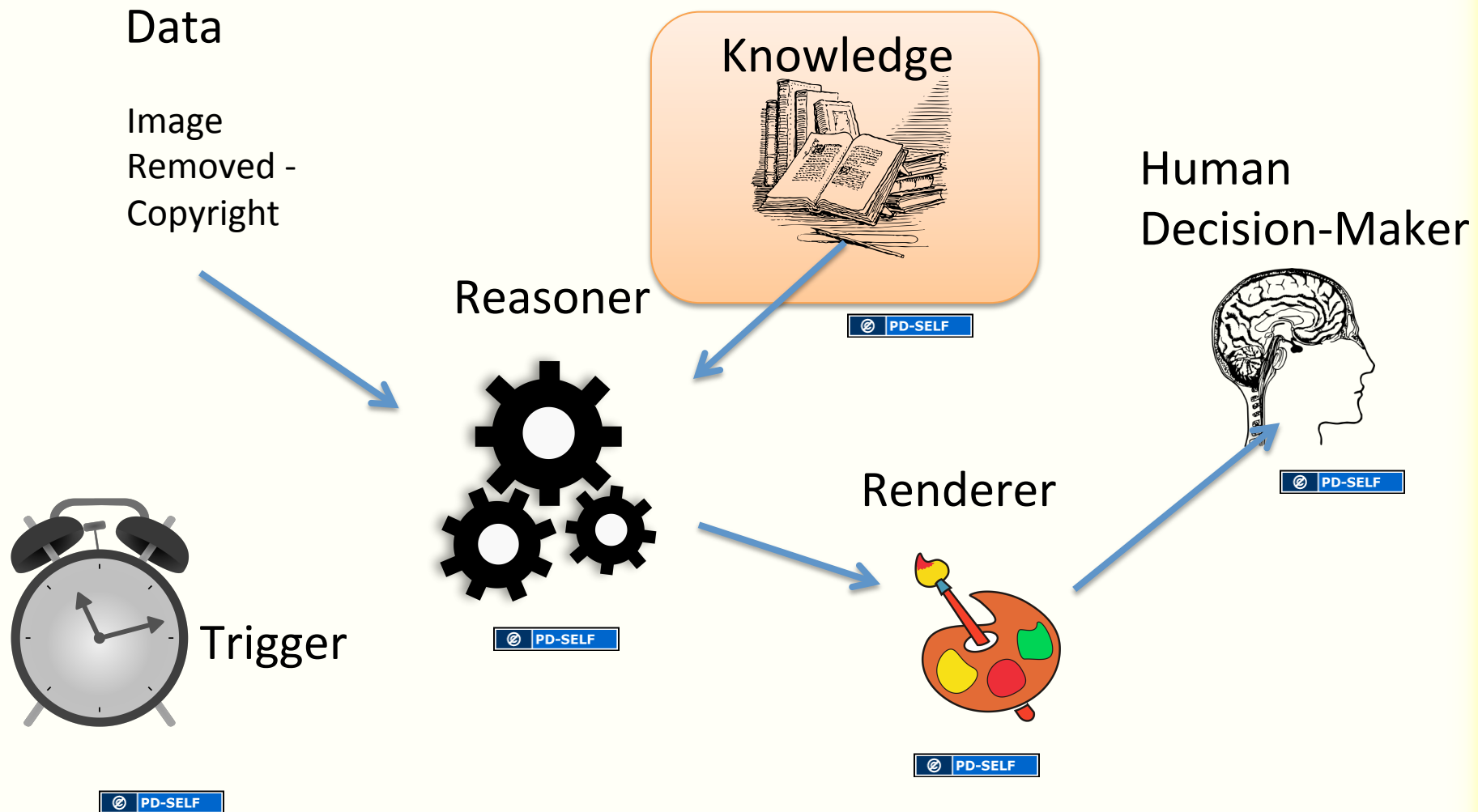
# Key Ingredients of Successful Advice-Giving

(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



# 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.

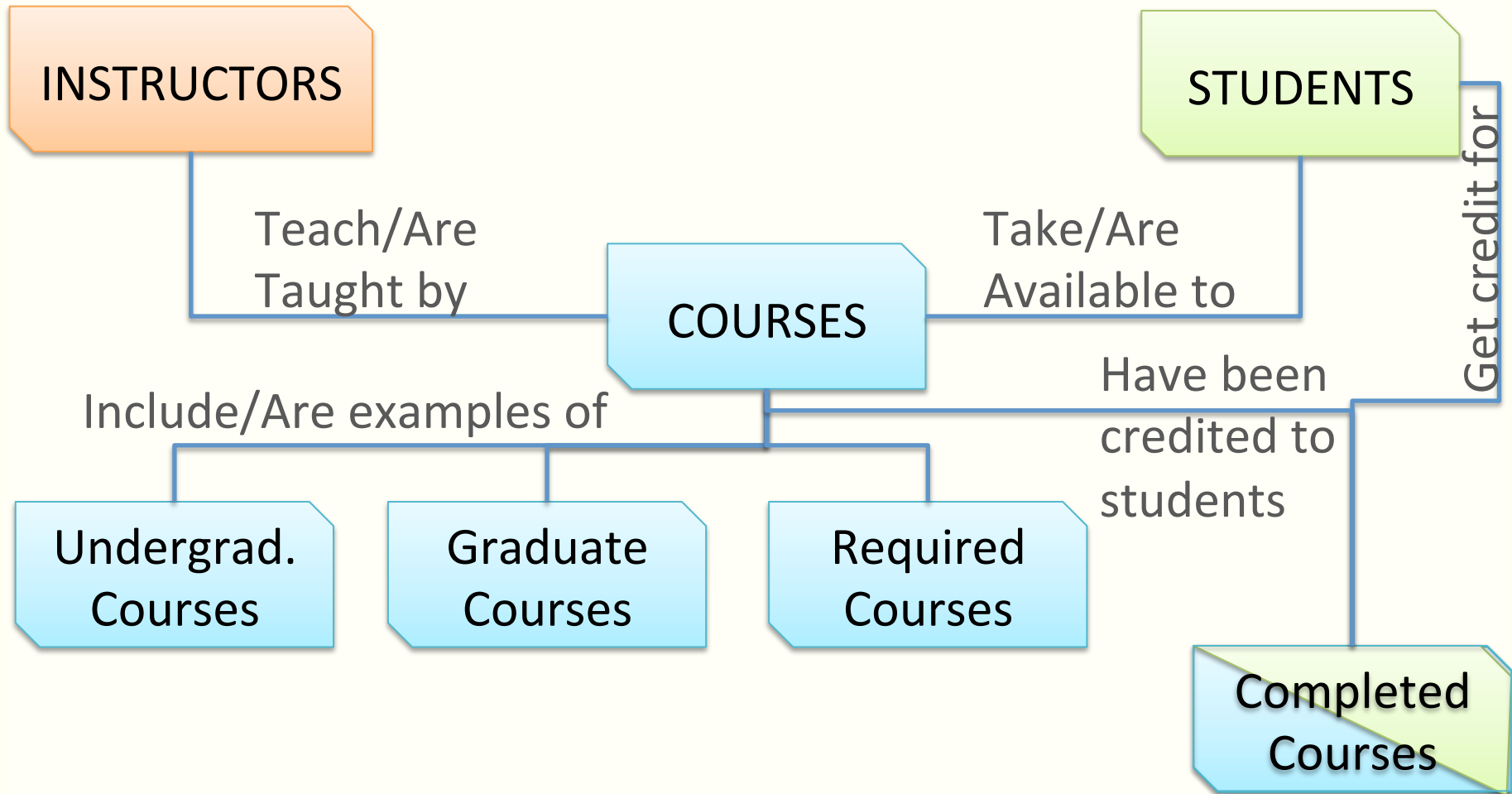
# Representation as Entities & Relations

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

\*Wordnet 3.0



# Entities & Relations

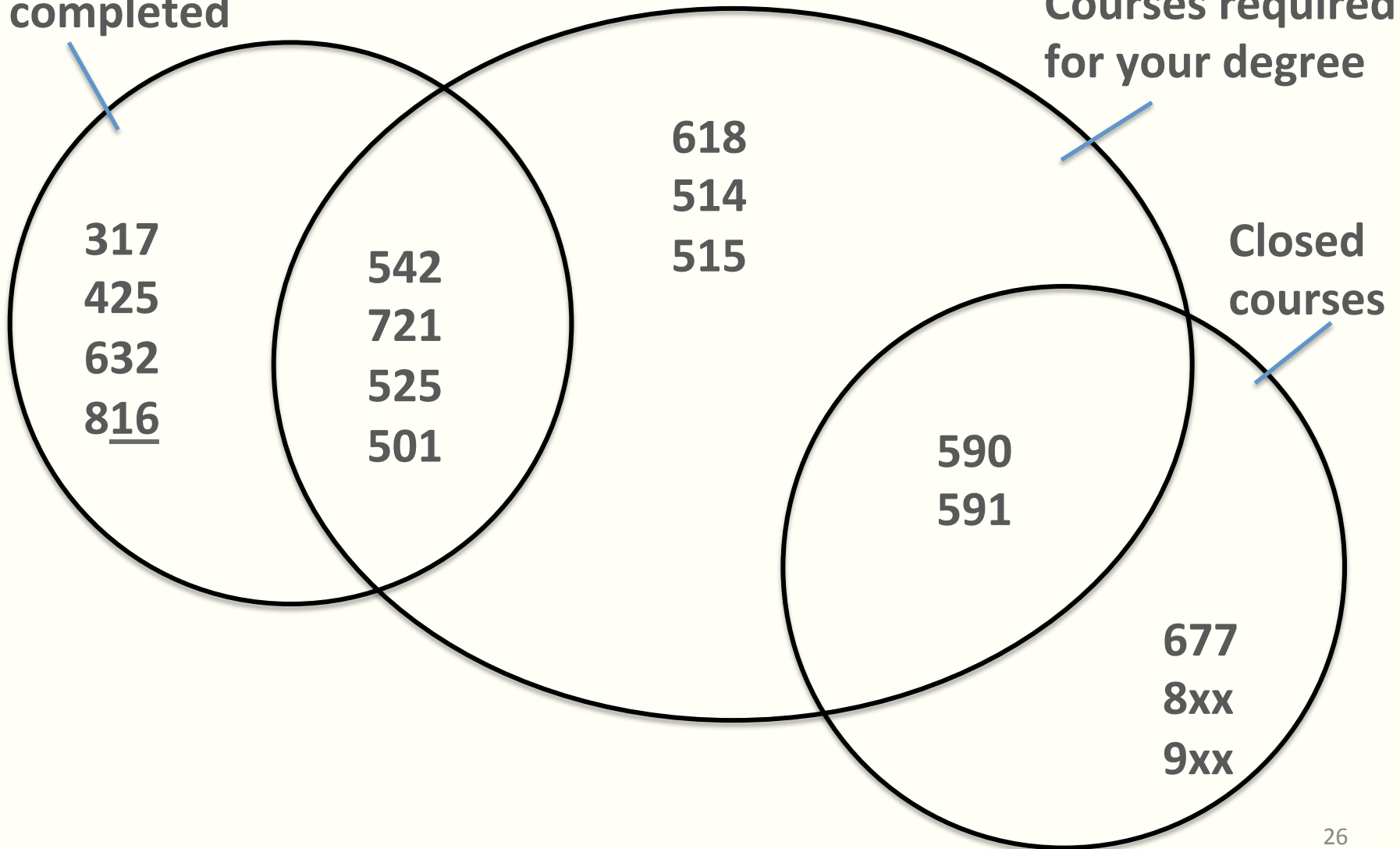


# Sets: Entities & Relations

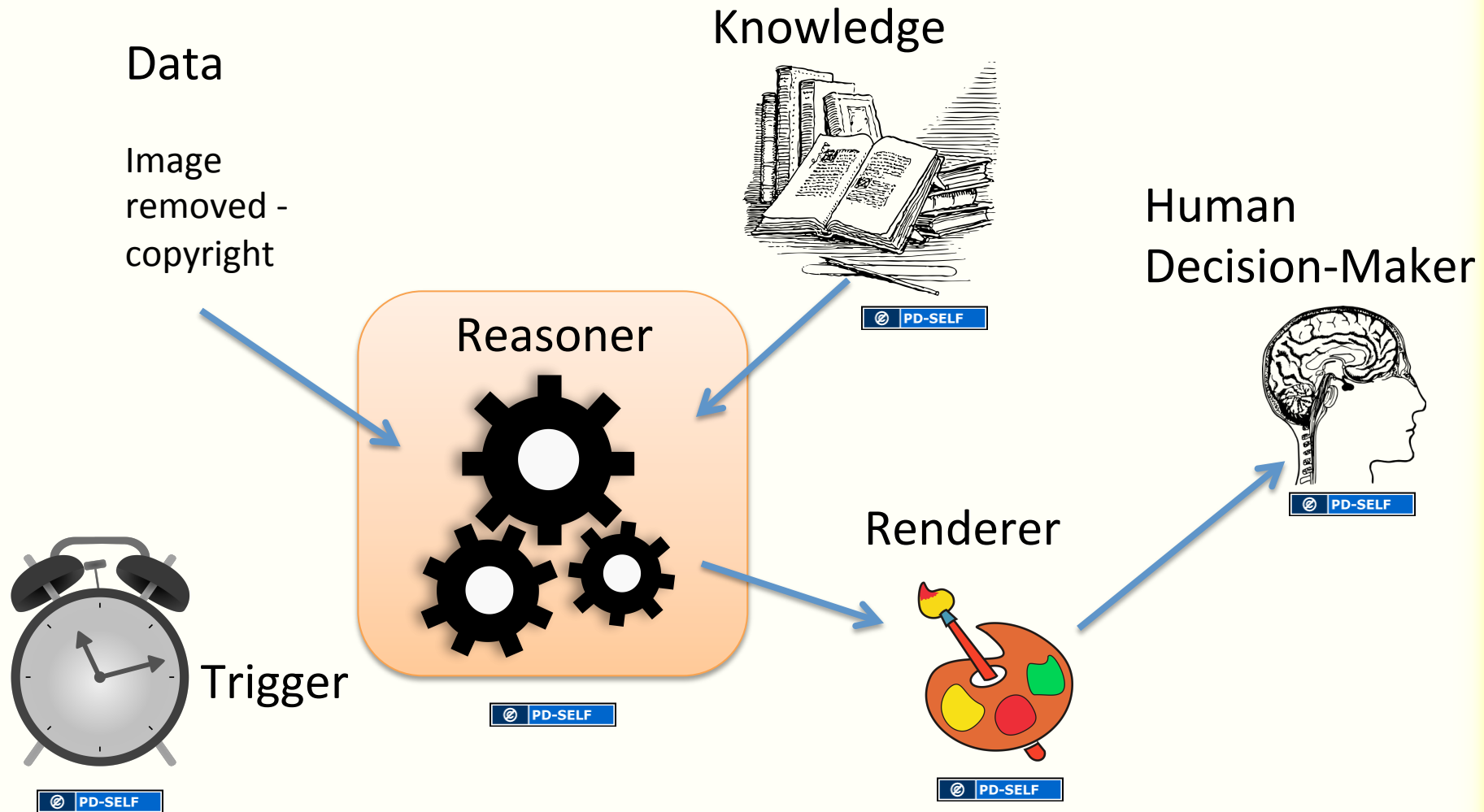
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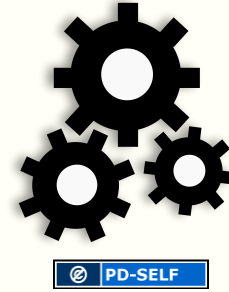
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# Advice-Giving System Architecture



# The Reasoner

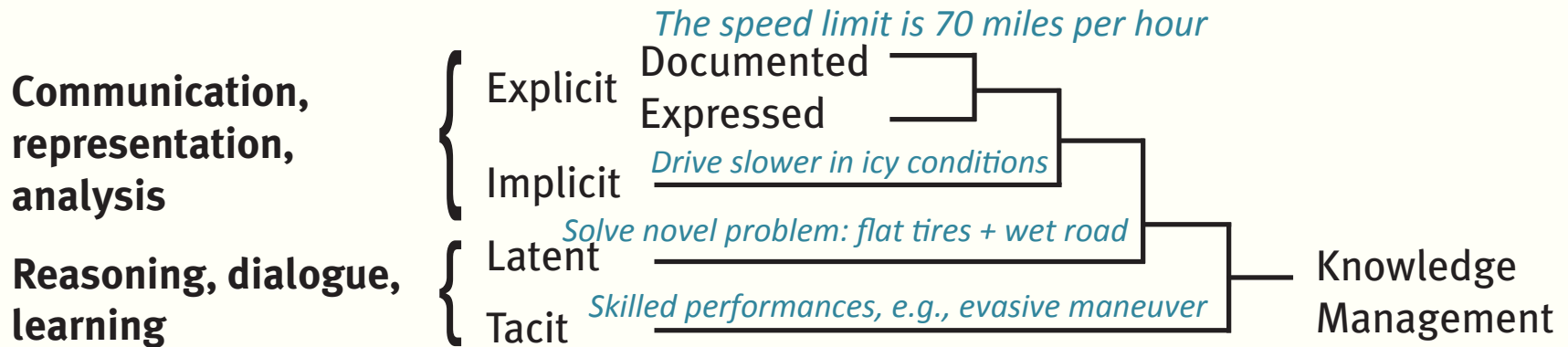


- The working of the reasoner depends on the **knowledge representation model**
- **Rules:** Logic operations that determine whether the rule “fires” or not
- **Sets:** Feed patient data to the model and infer a categorization or implication

*Can all knowledge be  
represented to make  
it computable  
by machines (IT)?*

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# Exhibit 8.1: Types of Knowledge



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

Implicit: Not expressed but communicated and understood

Latent\*: Present or existing, but in an underdeveloped form and not communicated

Tacit\*: Hidden from the consciousness of the knower

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

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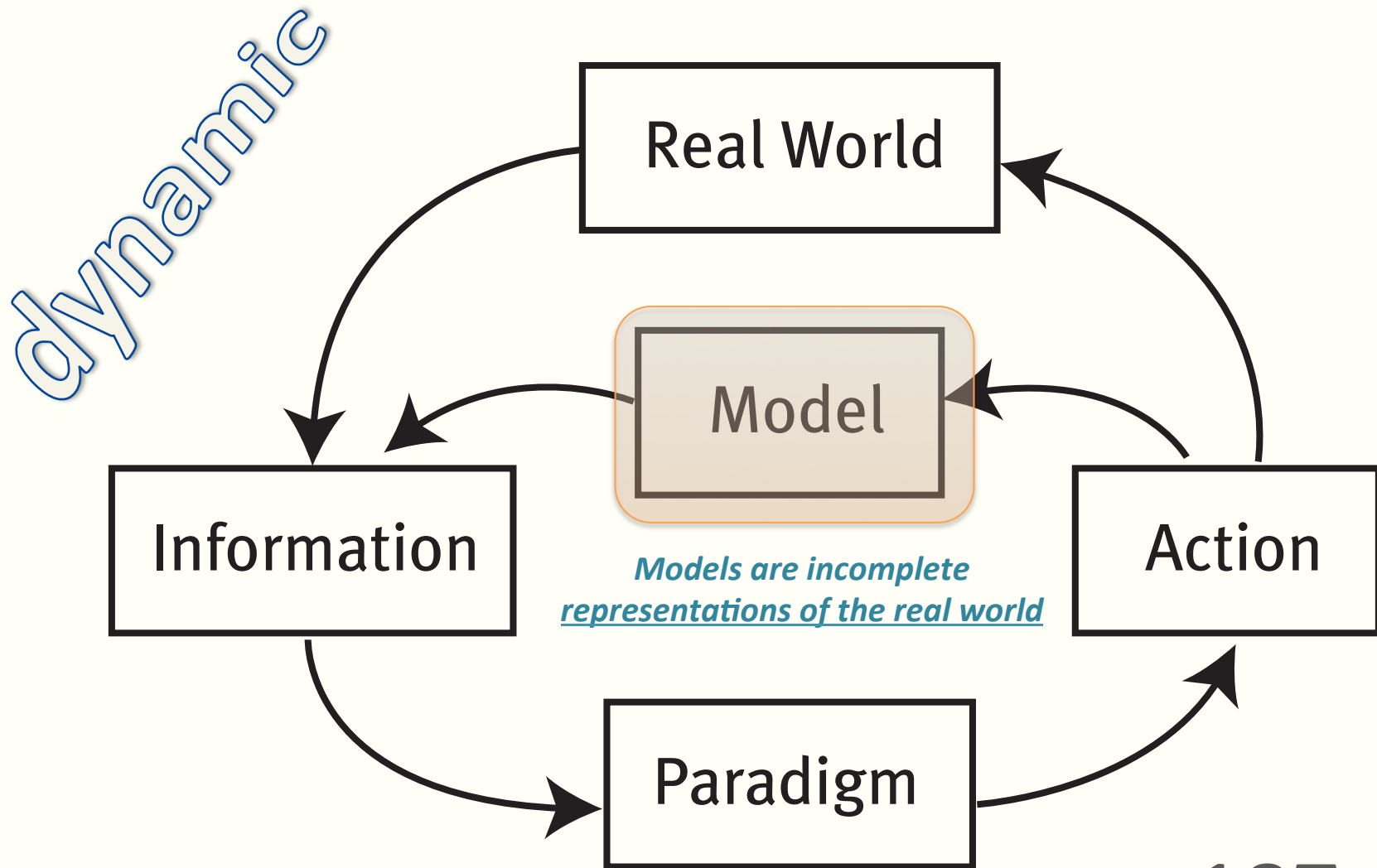
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# Modeling

- 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

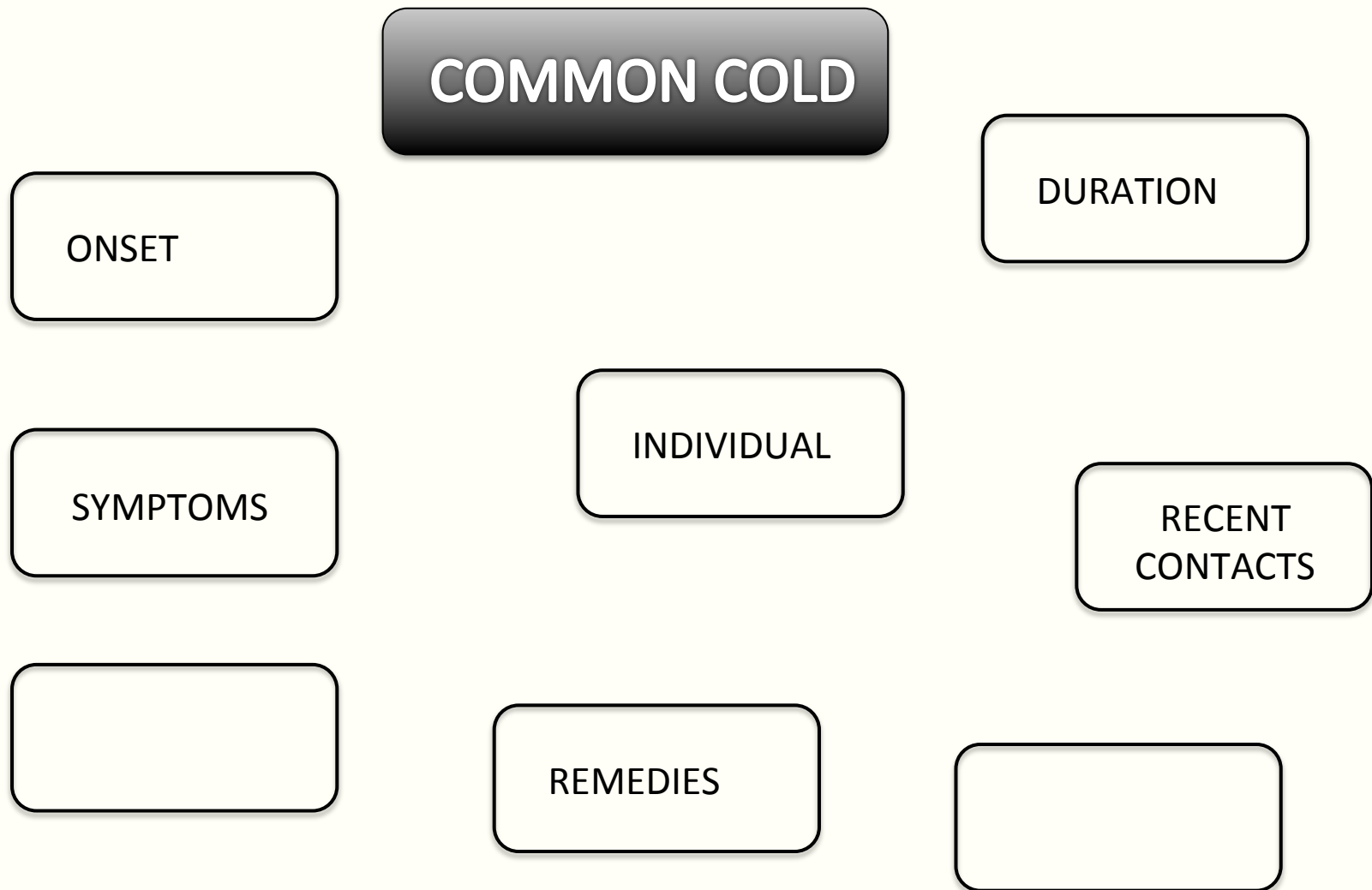


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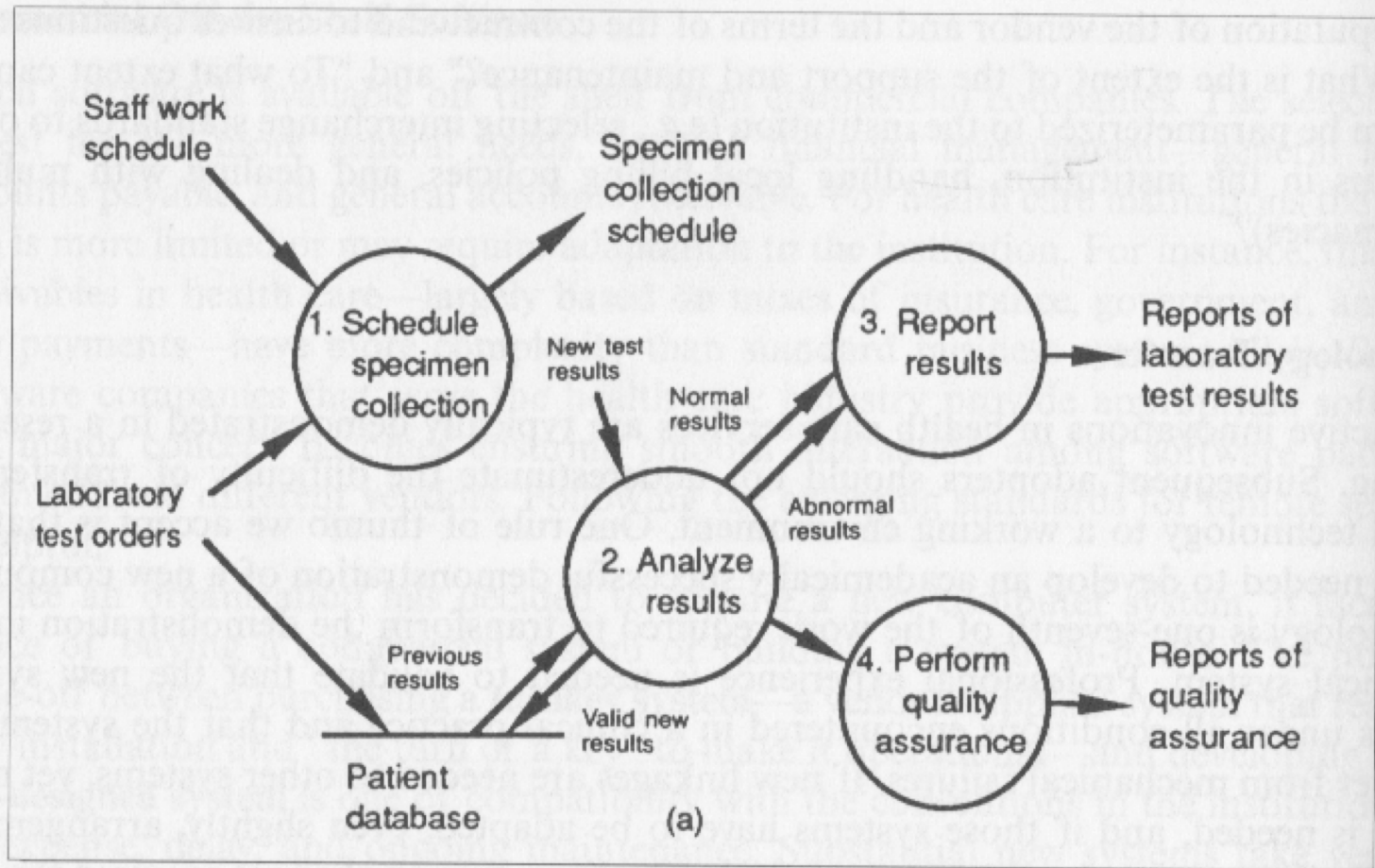
# Important Types of Models

- Data models
  - > includes entity-relationship models
- Decision models
- Information flow models

# Data Model – Common Cold



# Information Flow Models



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# 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

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- Content & materials for Skill Module 2

END

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