

Assessment of Learning

CMSC 19929: Creating Computer Games for Learning

How do you know if the player actually learns something through your game?

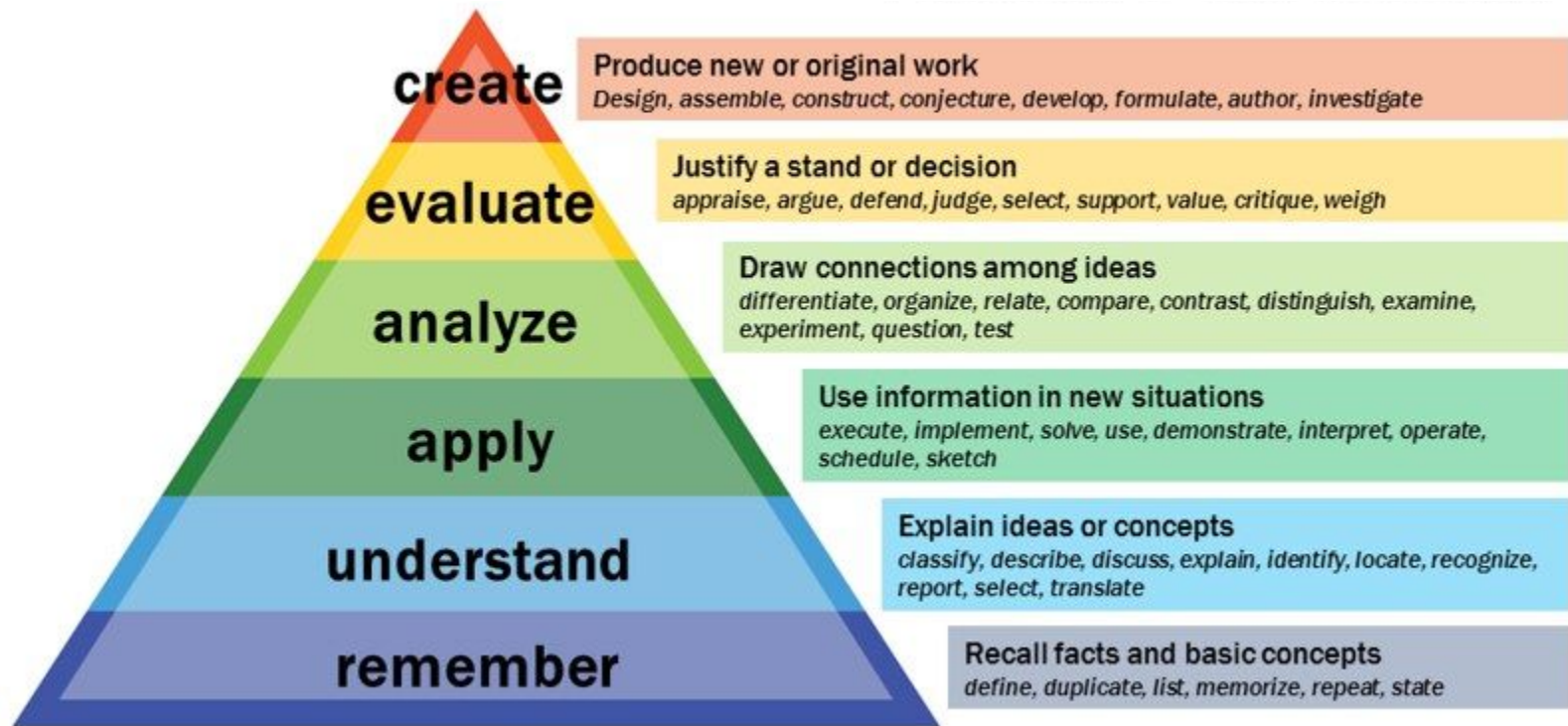


Discuss with your neighbors!

How do you know if the player actually learn something through your game?

- See if the player be able to answer the questions you ask
- questions should have enough variations so that the player can't brute force the answer
- look at the feedback / scores given to the player's answer
- comparing players' win/loss
- looking at which difficulty mode the player chose to play at
- able to complete a game level within a time limit
- provide some sorts of reflection form (e.g., survey, diary, journal - all in-game)
- chose to revisit some levels to earn more stars

Understanding Learning: Bloom's Taxonomy (1956)



Revised by Anderson & Krathwohl (2001)

Understanding Learning:

SOLO Taxonomy (Biggs & Collis 1982)

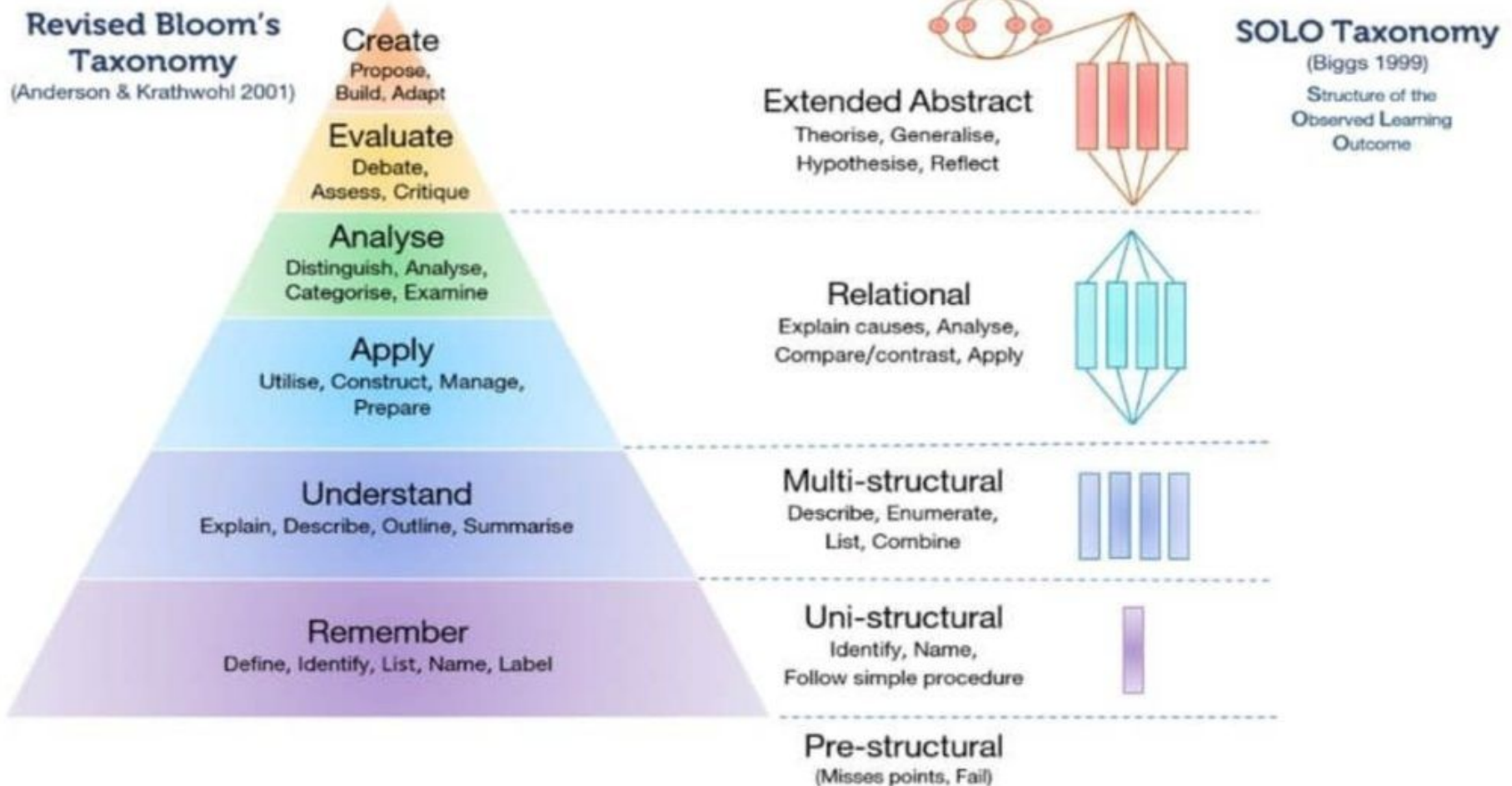
SOLO TAXONOMY				
	Define Identify Do simple procedure	Define Describe List Do algorithm Combine	Compare/contrast Explain causes Classify Analyze Relate Formulate questions	Evaluate Generalise Predict Create Hypothesise Reflect
				
Prestructural	Unistructural	Multistructural	Relational	Extended abstract

Teaching Teaching and Understanding Understanding



Breakout: Categorizing learning objectives in your own game

Bloom's and SOLO Taxonomies



Two Approaches to Assess Learning

- **Individual Learning Goals**
- Evidence-Centered Design (ECD)

Individual Learning Goals

- Design player-facing question that falls into each level of the taxonomy
- Analyze at what level the player answer the question

Example: *Civilization*

Build a civilization from one-two settler units

Start in different areas and time periods

Decisions:

- Where to expand

- Skills to learn

- Improvements

- Warfare vs Diplomacy



Civilization learning goals

- **Diplomacy** - how different civilizations interact
- **Strategy** - how decisions affect situations
- **Resource management** - constraints, fiscal
- **History & geography**
 - Significant historical events in the timeline and how they affected civilization
 - Historical buildings (7 wonders of the world)
 - Notable people from different geographical areas and periods in time
- **Technologies**
 - how they build on earlier technologies
 - when they were introduced
 - how they affected society

Breakout: Design school-based assessments for *Civilization*

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In groups, brainstorm a list of questions / activities someone can do **in the classroom** to assess *Civilization* learning goals.

Design **school-based** assessments for *Civilization*

- Compare the impact that one historical event had on a civilization compared to a different historical event
- Explain how one historical event caused or influenced a later historical event for the same civilization
- Compare and contrast how different countries have different diplomatic approaches
- Geography quiz - fill in city names on a map
- Given a situation, analyze different diplomatic situations
- New trade deal - create a plan for diplomacy

School-based assessments

- (e.g. Where Rome is)
 - Word bank: identify advantages and drawbacks for starting points for civilization
 - Order historical events
 - Provide a fact and ask them to explain why (e.g. this city had little contact with other people – explain why)
 - Provide a map and have them label the cities on it

School-based assessments

- (e.g. relationships involving geographical, historical, and economic systems within and across civilizations)
 - Design a resource that could join civilizations together – a new mechanic or resource to the game and describe how the game / relationships would be impacted
 - What are the advantages of performing diplomacy instead of waging territorial war with them?

Breakout: Design school-based assessments for *Civilization*

- **Diplomacy** - how different civilizations interact
- **Strategy** - how decisions affect situations
- **Resource management** - constraints, fiscal

What are some benefits/drawbacks of school-based assessments?

- Notable people from different geographical areas and periods in time
- **Technologies**
 - how they build on earlier technologies
 - when they were introduced
 - how they affected society

In groups, brainstorm a list of questions / activities someone can do in the classroom to assess *Civilization* learning goals.

Evaluate school-based assessments

Benefits

Drawbacks

Breakout: Design in-game data collection assessments for *Civilization*

- **Diplomacy** - how different civilizations interact
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 - Significant historical events in the timeline and how they affected civilization
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In groups, brainstorm ways to to incorporate questions or some other activities someone can do **in game** to assess *Civilization* learning goals.

Design in-game data collection assessments for *Civilization*

- Embedding a diplomacy decision within the game, have it play out and show results
- Diplomatic situations allow you to test about geographical knowledge
- Receive letters from foreign rulers. To access them, you have to identify what country the ruler is from.
- If you approach a country to negotiate, you are stopped by a diplomat at the doors, and they ask who you want to see. You would need to answer with the ruler's name
- Resource management: Historical buildings that are expensive but no strategy value, and they are a proxy for excess cash / good money management.

In-game data collection

- In-game advisor prompts them with a specific situation and they have to decide what to do
- Diplomacy aspect – give a 1 or more quiz questions about a civilization to “earn” a better relationship
- Remove the map labels and see if they can “go the right place” when asked to

Breakout: Design in-game data collection assessments for *YOUR GAME*

- Review the list of learning goals in your learning trajectory
- Brainstorm several ways you would assess the player's learning

Remember: You don't need to assess every single learning goal! Some might be impossible to assess within the limited game environment and playing time.

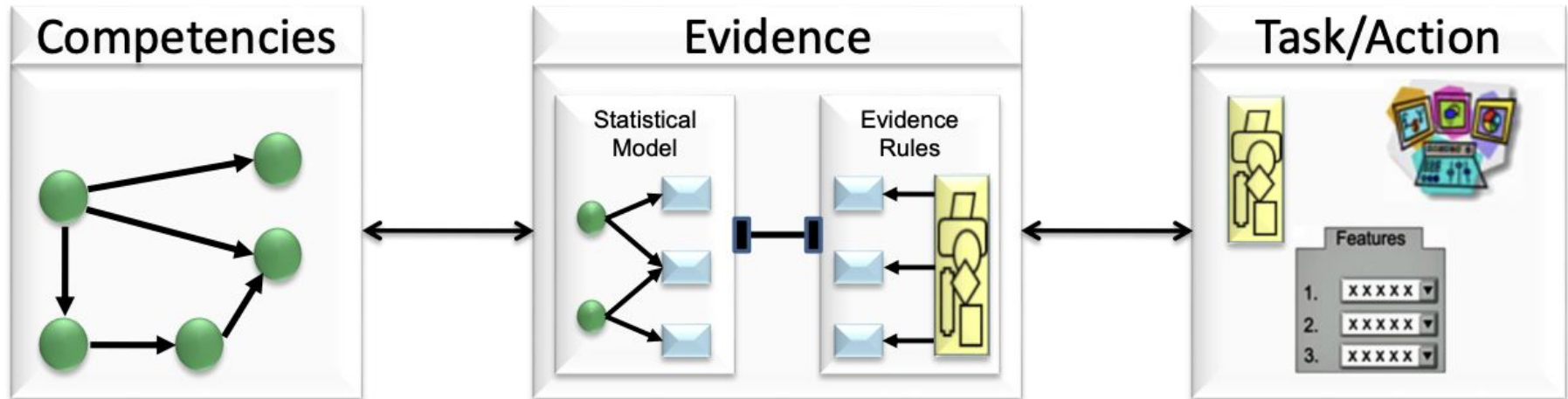
Two Approaches to Assess Learning

- Individual Learning Goals
- **Evidence-Centered Design (ECD)**

Evidence-Centered Design (ECD)

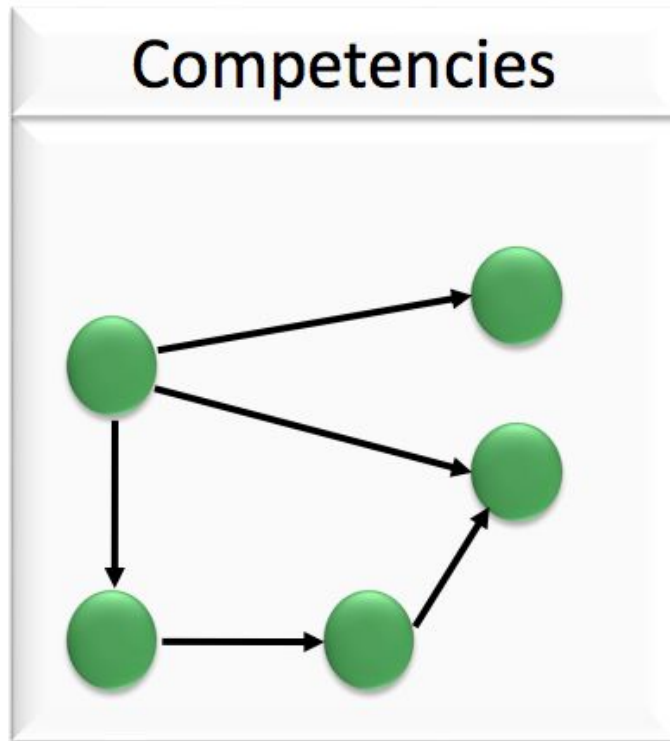
ECD is an assessment framework that systematically links **learner competencies** to **observable evidence** generated through **specific tasks or actions**.

Assessment Models and Metrics



Monitor and Diagnose Success

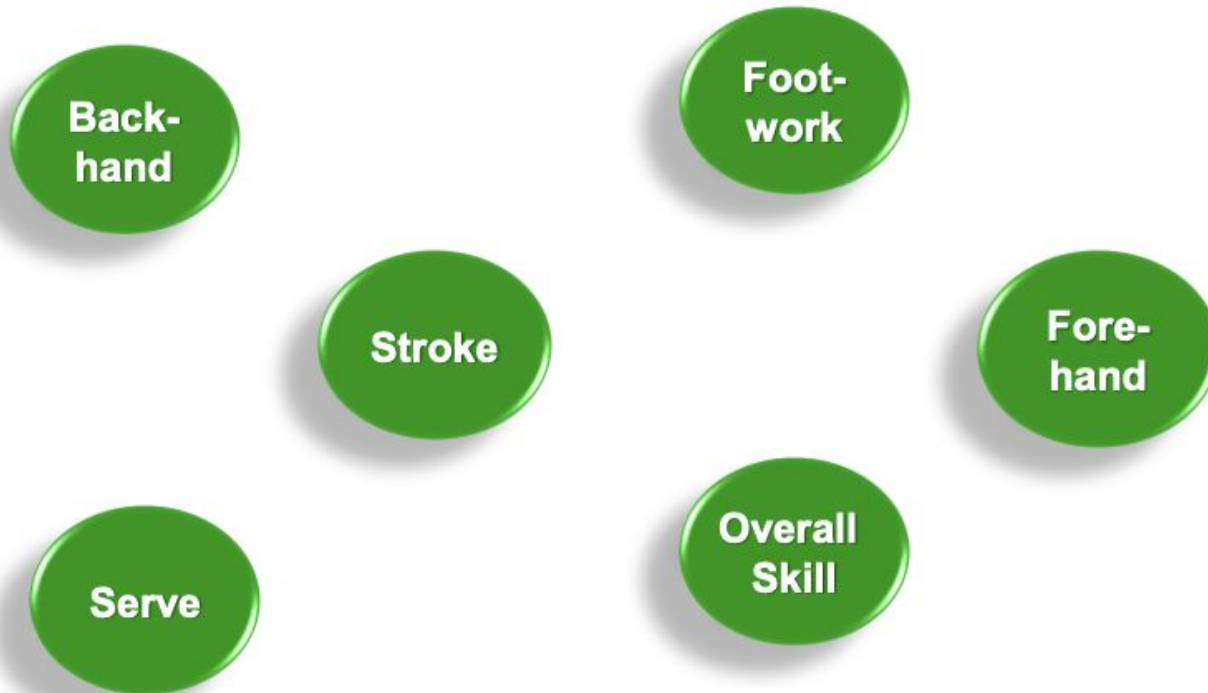
Competency Model (CM)



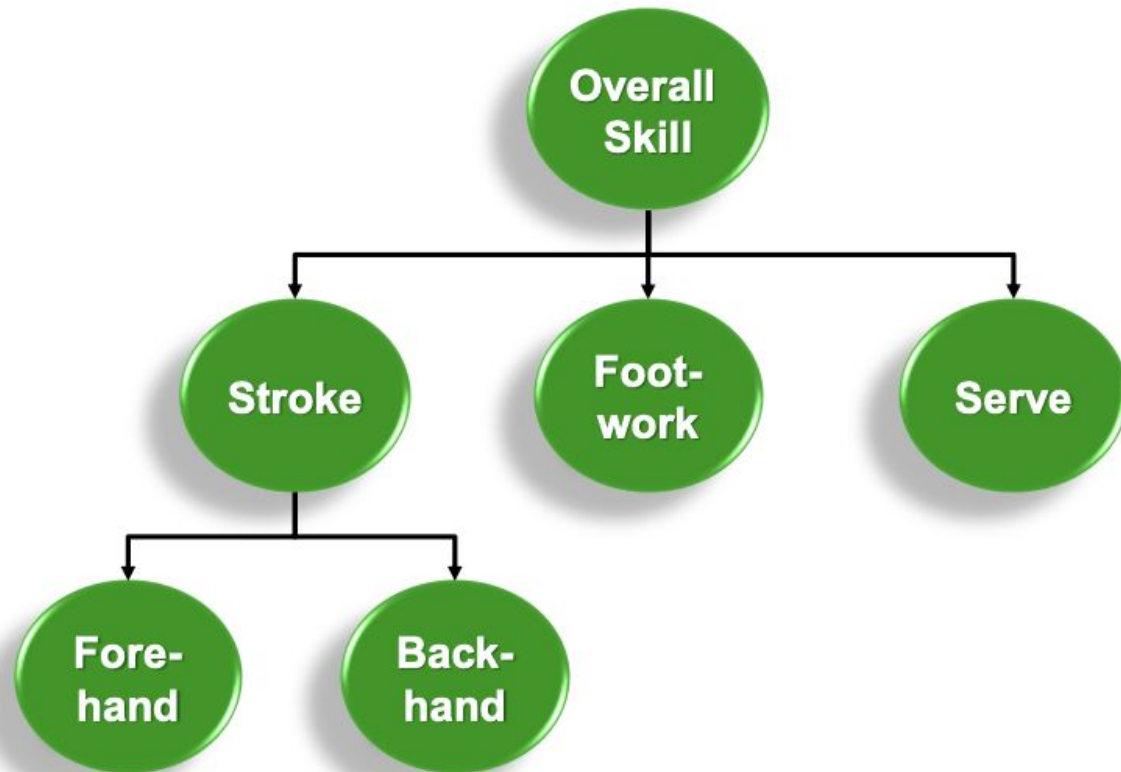
- Variables (green circles) in the CM describe knowledge, skills, and other attributes about which inferences are intended.
- Inferences can be at various grain sizes, from general (e.g. *Maya's math skills are high*) to more specific (*Jeb is having serious problems solving linear equations*).

Selecting CM variables

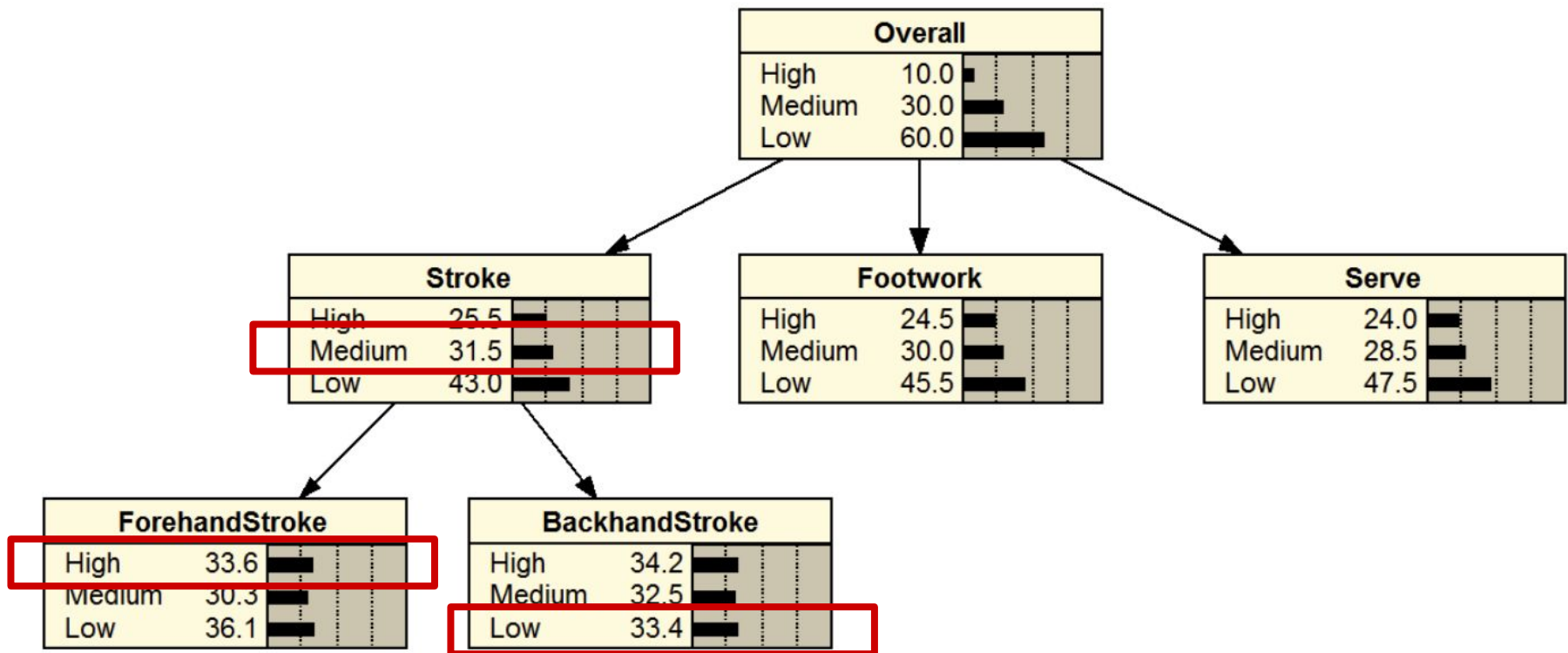
- Suppose you wanted to make a claim about a person's ability to *play tennis*. What would you use for your variables? What skills does a good tennis player need to have? What do novices do?



Structuring CM - conceptual



Structuring CM - computational

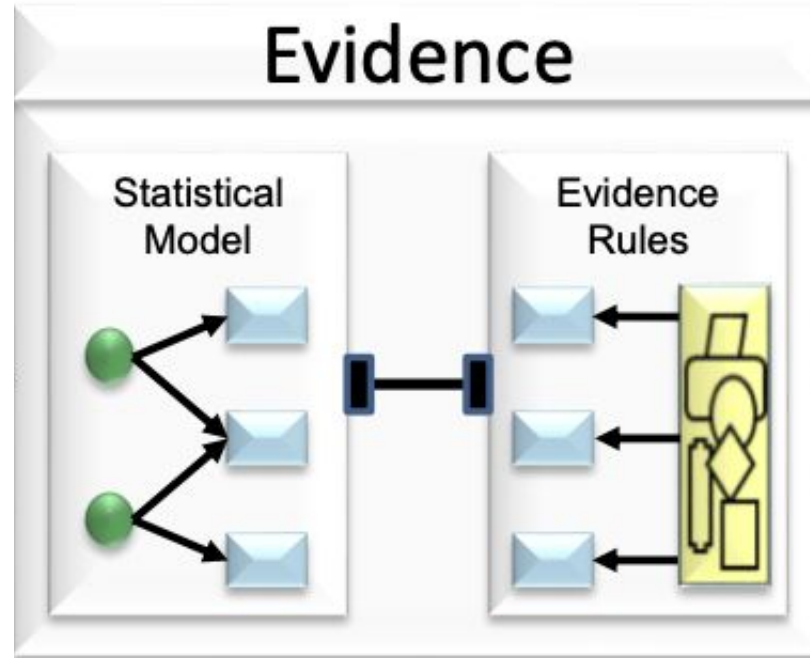


This is an example of a probability distribution of the variables.

Evidence Model (EM)

Two key components:

- Evidence rules
- Statistical model (not discussed in this class)

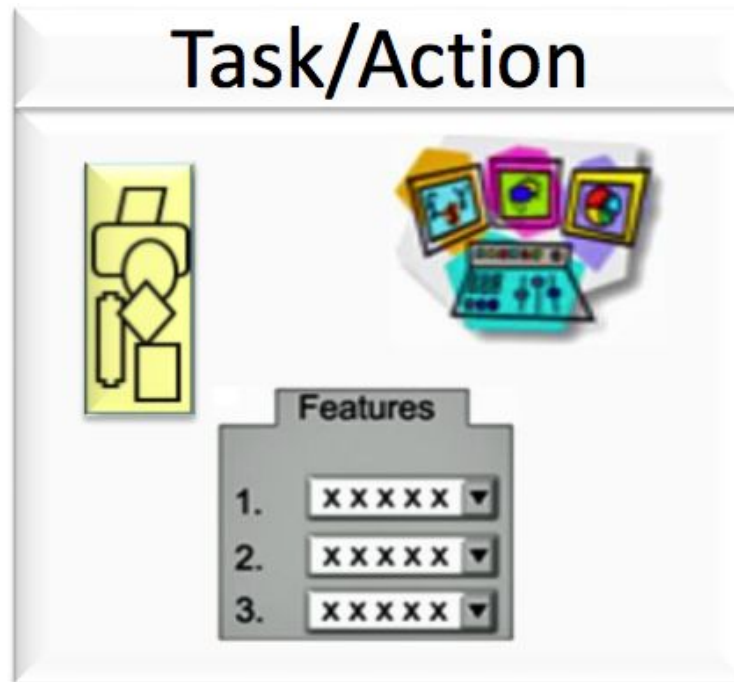


Identifying **evidence** for a single learning goal

Indicators\Score	0	1	2
Form of forehand stroke	Improper form	Proper form, but timing off	Proper form and good timing
Control of the ball's direction with forehand stroke	The ball landed outside of the line.	The ball landed inside of the line, but in an easy spot for the opponent to hit.	The ball landed inside of the line, but in a very hard-to-hit spot for the opponent.
Power of stroke (longer, shorter, and follow through)	The ball didn't cross the net, or the ball went too far.	The ball crossed the net, but provided a scoring opportunity for the opponent.	The ball crossed the net, but it was difficult for the opponent to keep the ball in play.

Task/Action Model (TM)

- Design tasks that allow learners to provide evidence that demonstrates competency



Breakout: Pick **one** learning goal from your game

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It's okay to just have 2 indicators