Learning about Learning

- **Two hallmarks of a great engineer/computer technology person:**
  - **An ability to teach themselves new skills**
  - **The ability to communicate with/lead others (i.e., teach others)**
- **Today, we explore learning in some depth. Why do we do so?**
  - **These are skills that almost no one your age has yet learned**
  - **These two skills can make your career as a student successful – no matter what field of study you choose to pursue.**

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What is Learning?

- **In recent decades, research on learning has yielded important knowledge about the nature of learning and teaching as it takes place in a variety of environments.**
- **This knowledge includes important principles for structuring learning experiences that enable people to use previous learnings in new settings.**
- **Principle: "Learning" is adapting your thoughts to match what you observe.**

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Considering Each Part of the Definition

- "'Learning' is adapting your thoughts to match what you observe." (Emphasis on first part of definition.)
- Does this mean your past affects your learning?
- Absolutely!
  - Learning is affected by cultural norms.
  - If you grew up in rural North Dakota, your background is far different than if you grew up in downtown London.
  - For instance, in London, you would have extensive experience with mass transportation, densely-populated apartment complexes, and a wide variety of restaurants, things that someone from rural North Dakota might never have seen.
  - Everyone - even babies - have ideas that affect learning.
  - Everyone will learn in slightly different ways.

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Learning (2)

- **Consider the last part of "learning is adapting your thoughts to match what you observe."**
- **If you don't 'experience' something can you learn from it?**
- **Not at all!**
  - **Good teachers know this, so that they have 'tricks' to get students to observe new items.**
  - **Thus as an engineer or computer scientists (or a student headed in that direction) can use these definitions to both learn now and perhaps teach others in the future.**

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The Huge Value of "Experience"

- **This idea of "Experiential Learning" is exemplified by the Confucian saying:**

  Tell me and I forget.

  Show me and I remember.

  Let me and I understand.

- **Let's try an experiment…**

("Tell Me" Exercise)

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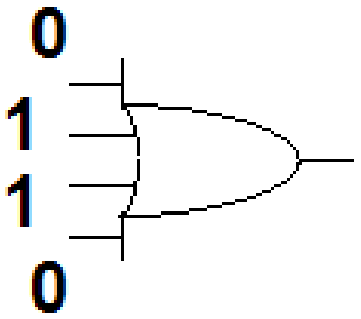
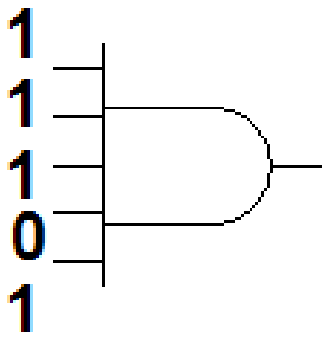
Test for Our "Guinea Pigs"

- **In the circuits to the right, what is the logical output of each?**
- **State as simply a 0 or 1.**





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So, What Did We Learn?

- **Single-path learning stimulation provides very marginal results. (Tell – only aural stimulation, no visual complement).**
- **Reinforcing simple telling with a visual component greatly increases learning.**
- **Supplementing visual and aural inputs with actual experience (doing it) "locks in" the learning process and provides the key to skill mastery.**

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Sensory Reinforcement

- As babies, all of us learned by using all of our senses.
- We touched, tasted, looked at, listened to and smelled everything - including dirt, leaves, the sidewalk, and so forth.
- We OBSERVED using all the sensory paths and experience mechanisms we had.
- In using all these experiential pathways, we learned very rapidly.
- Ever wonder why a baby or small child learns so fast? Easy: It uses all the sensory avenues to reinforce the learning experience!

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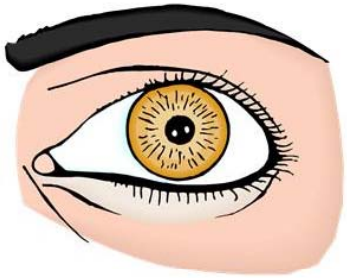
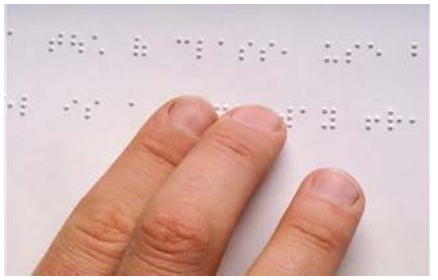
A Primary Learning Channel

- **Although we use all our sensory pathways to learn, most humans have a primary learning style. The three primary learning styles are:**
  - **Aural: The primary learning pathway or sensory channel is the auditory pathway.**
  - **Visual: The primary learning pathway or sensory channel is the visual pathway.**
  - **Tactile: The primary learning pathway or sensory channel is the touch/feel neural pathways.**





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Primary Learning Style

- **Let's take a quick test to determine your primary learning style.**
- **We now understand that using different learning styles (different sensory pathways) can reinforce and improve the learning experience, so this test isn't just for fun.**
- **If you know your primary learning style, you can intelligently determine which supplementary learning styles you use to reinforce each learning experience.**

(Learning Style Test)

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Learning to Supplement

- **Hopefully you have gained an inkling of your primary learning mode.**
- **Now that you know that primary mode, you can supplement the primary sensory pathway with supplementary reinforcement.**
- **For instance, a visual learner can reinforce by pronouncing names as he/she studies. This aural reinforcement can enhance the learning experience.**

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An Illustration of Learning

- **A way to illustrate the experience-evaluate-learn process is illustrated by another Chinese saying: "Learning is from thin to thick to thin."**
- **What does this mean?**
  - **As you begin to learn something, you know very few details (THIN).**
  - **Later in the learning process, your experience provides many more details (THICK).**
  - **As the learning experience runs its course, you begin to see simple patterns or generalizations (THIN).**

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Learning Model for Adults

- **This learning experience can be generalized using a model by David Kolb (thanks to Matthew Goeckner for this model):**
  - **Learning starts when you experience something new (i.e. acquiring "Thin Knowledge").**
  - **The richer the experience (more information, more neural pathways), the better the learning.**

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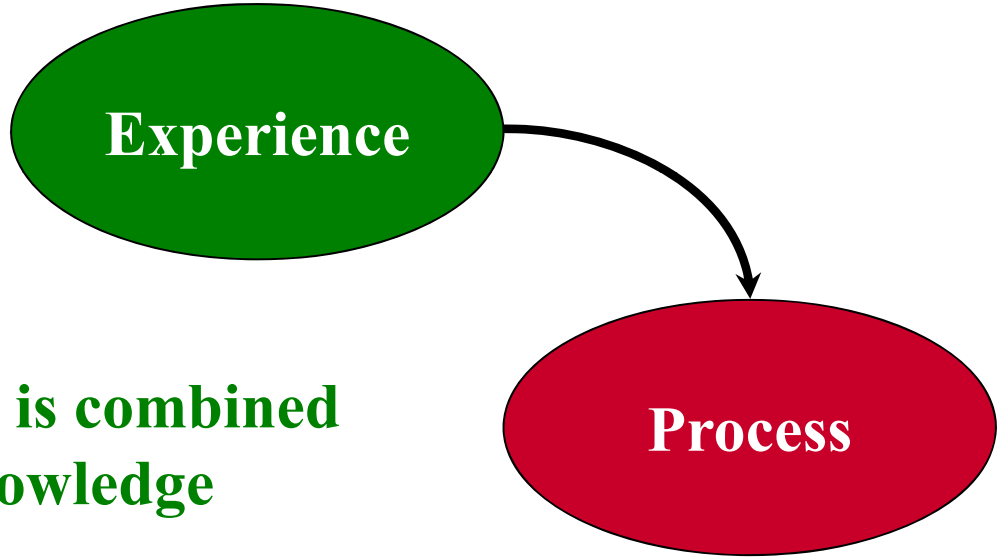
Learning (2)



- **New information is combined with previous knowledge (thin→thick).**
- **This is the processing function on the information accumulated.**

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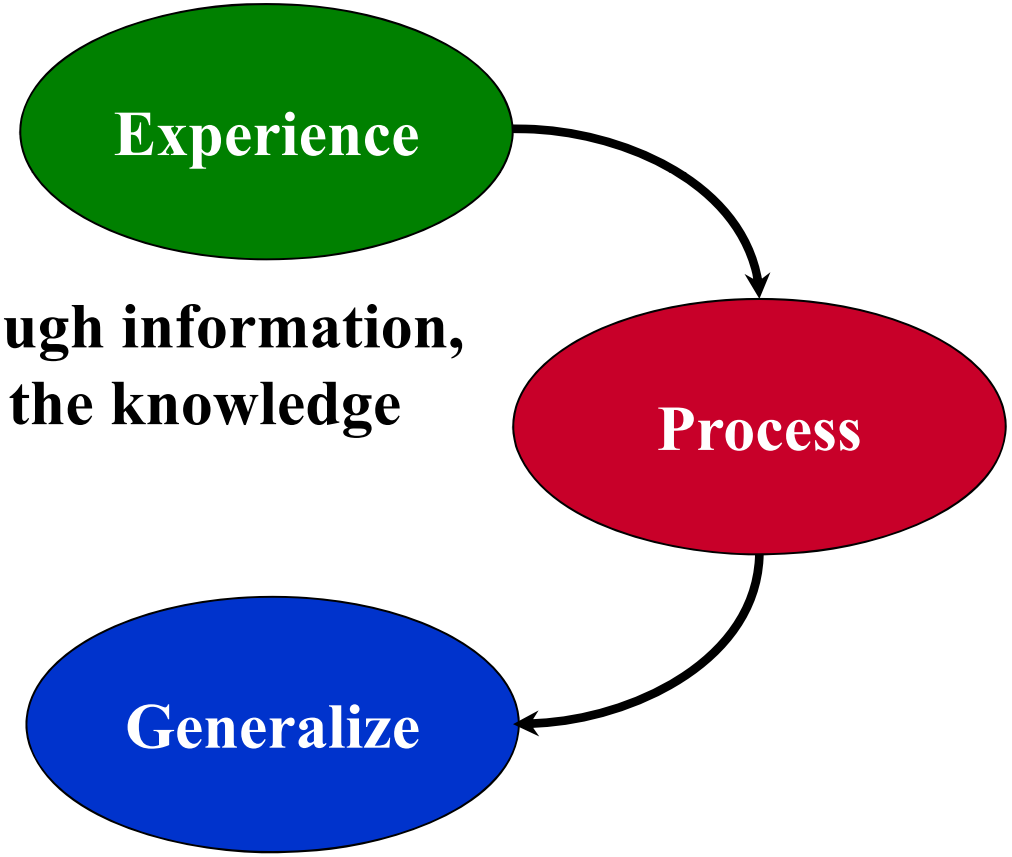
Learning (3)



Once you have enough information, you can generalize the knowledge (thick→thin).

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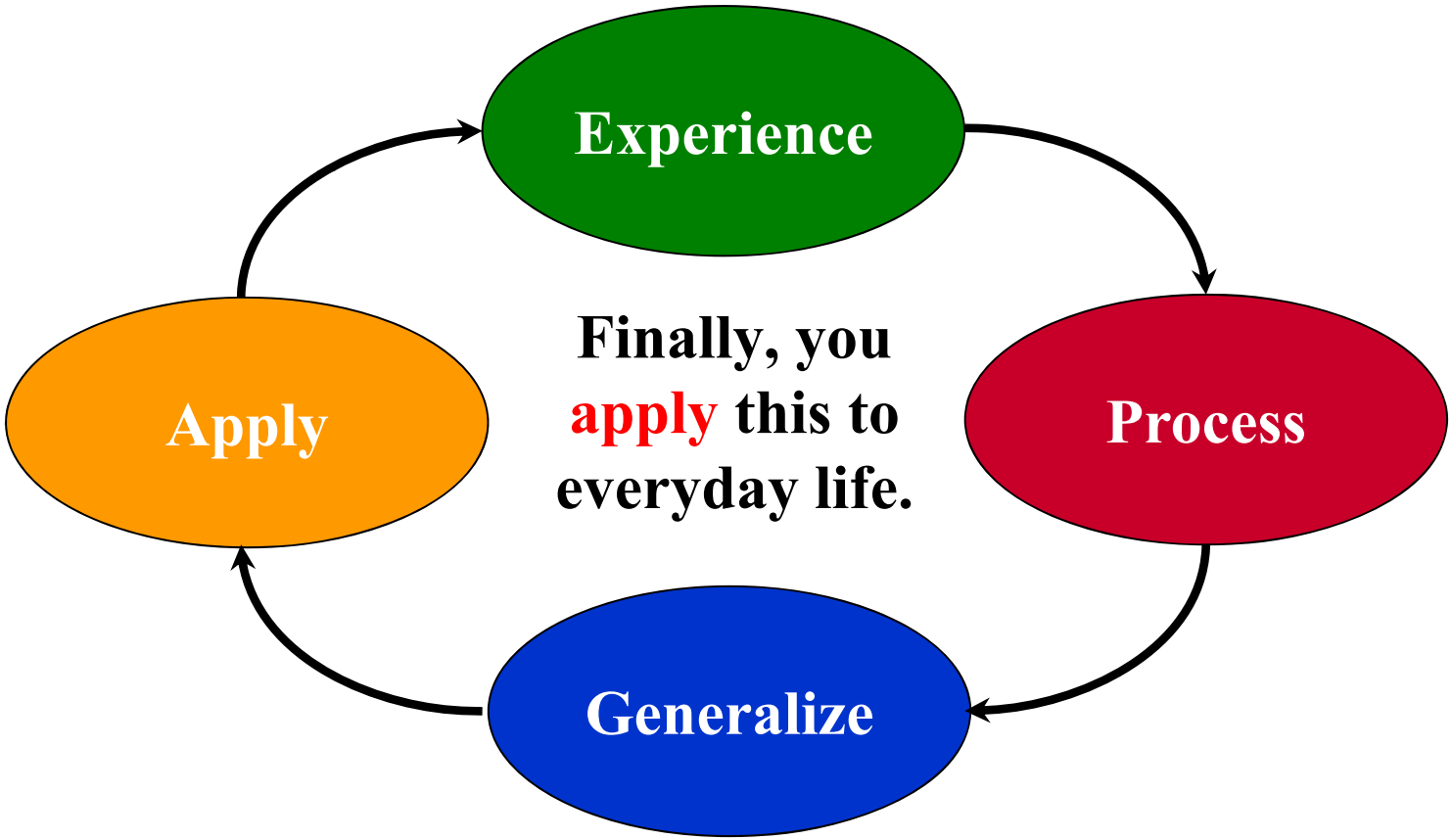
Learning (4)



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Learning and "Agents"

- **Marvin Minsky was (and is) one of the great researchers in artificial intelligence. He also did important research in child development (i.e., the learning process of the developing brain).**
- **In his book, "The Society of Mind," Minsky declares that our brain is not simply hundreds of millions of neurons working haphazardly to develop knowledge and skills.**
- **Instead, neurons "learn" by forming groups that develop and perfect an area of knowledge or skill.**
- **Minsky called these groups "agents."**

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Simple View of Brain in Cross-Section

Cerebral cortex (~ 3 mm covering)

Cerebrum ("new brain")

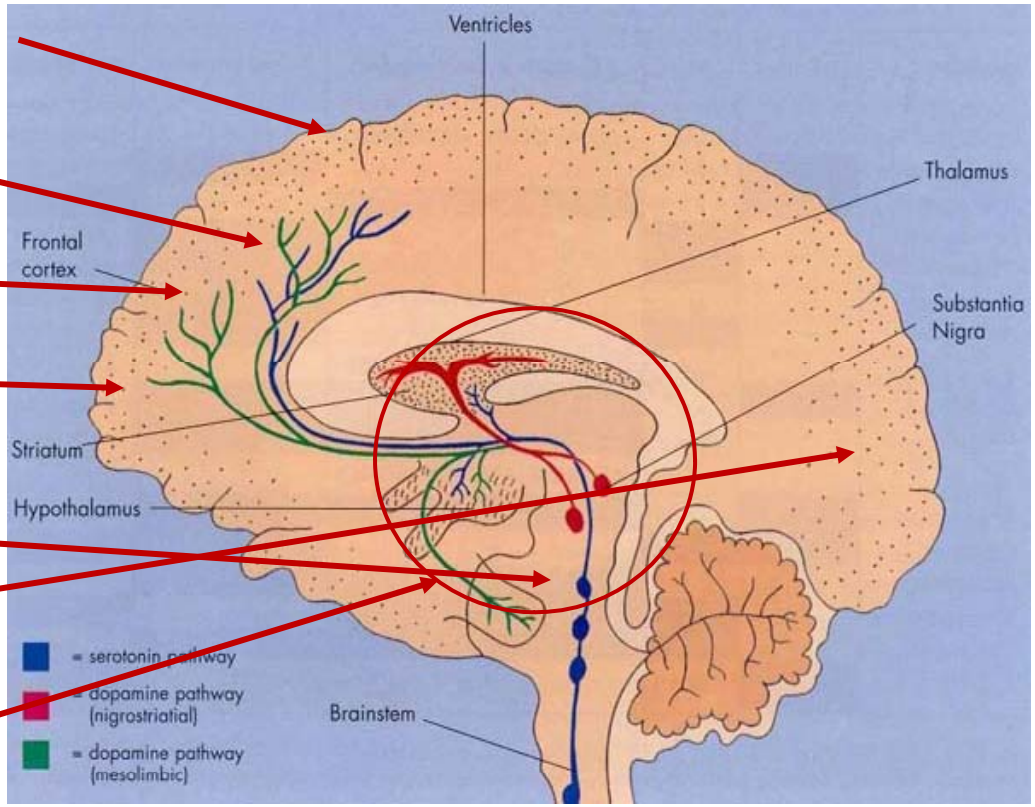
Higher level thinking

Speech

Hearing (outer structure)

Sight

Area of "old brain" (inner structure)



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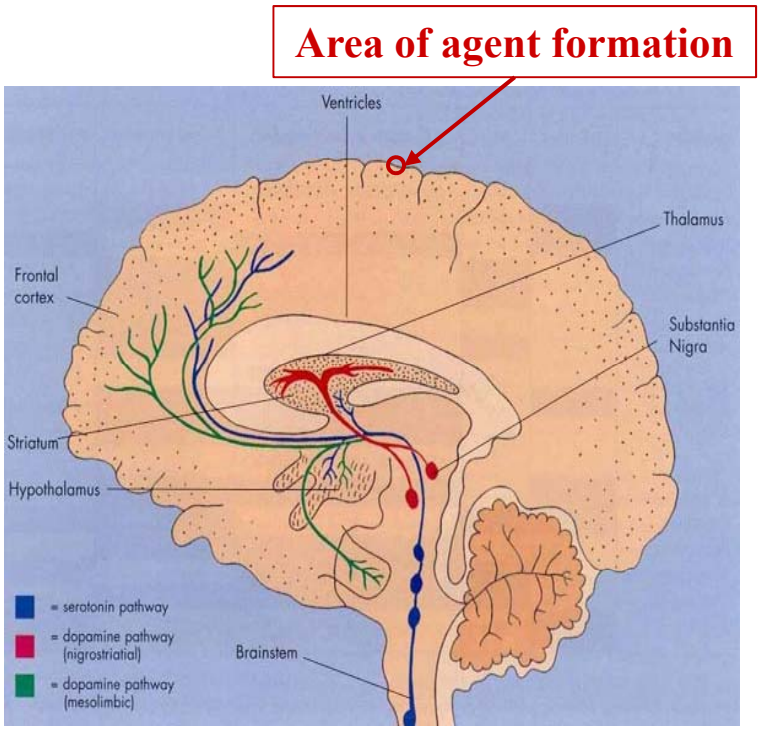
"Agents"

- **According to Minsky, learning was simply the development of new agents, which accumulated experiences, cross-referenced with current knowledge, and developed a new area of knowledge or skill that was "activated" when it was ready for action.**
- **Agents can outlive their usefulness and go inactive, be replaced by newer ones, or be periodically updated as knowledge and correlation improved.**
- **These hundreds of thousands of "agents" make up, according to Minsky, "intelligence."**



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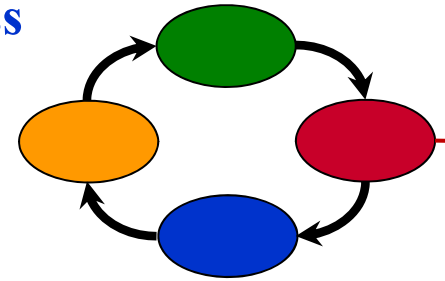
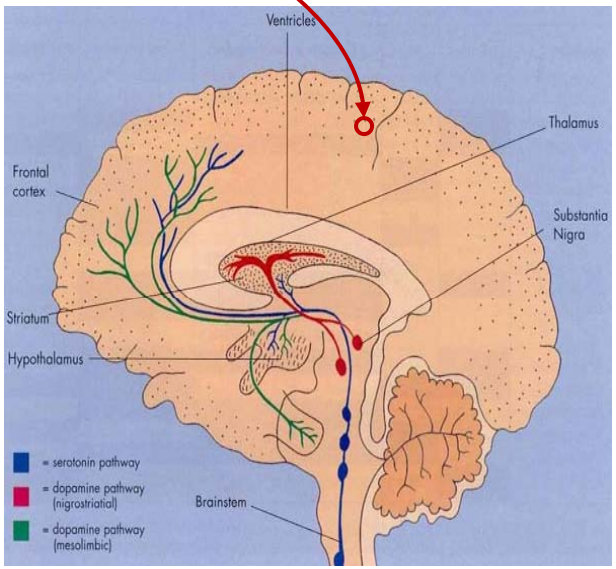
Agents and the Process

- Our four-stage process can be seen as a diagram of the way Minsky's "agent creation" works.
- Let's see how we might apply the sequence of actions represented by our process, keeping in mind how it corresponds to what Minsky calls "agent creation."





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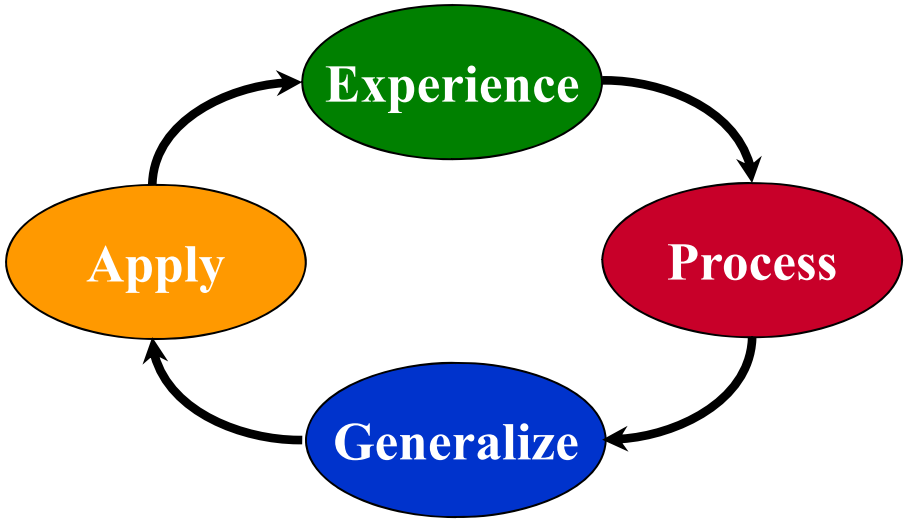
Using The Process

- The process diagram is shown again at the right.
- Remember that we can use the idea of the experience loop to improve the ability to learn (improve "agent" building).
- Each step is important in the learning process.



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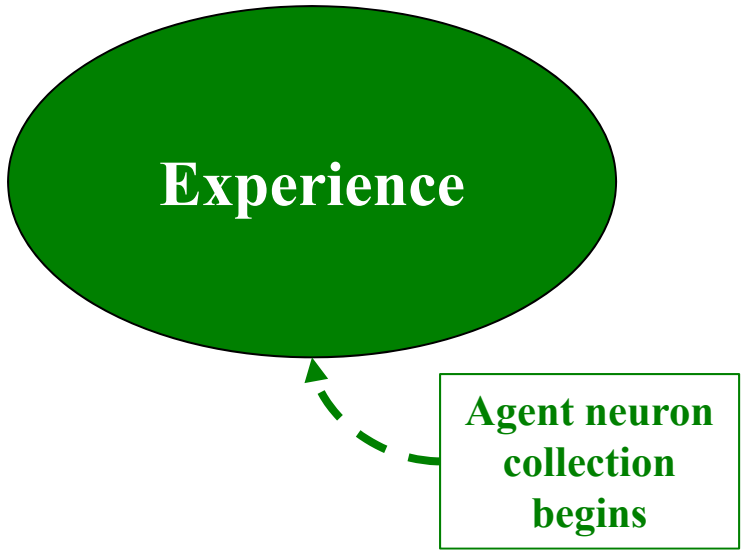
Using The Process (2)

- **When learning something new:**
  - **Include many senses and sources (to deepen the experience):**
    - **Read other books for different views.**
    - **Use sound/vision etc. as available.**
  - **Don't get distracted.**
    - **Focus!**
    - **Block out other experiences**
- **YOU can even overcome a bad teacher!**



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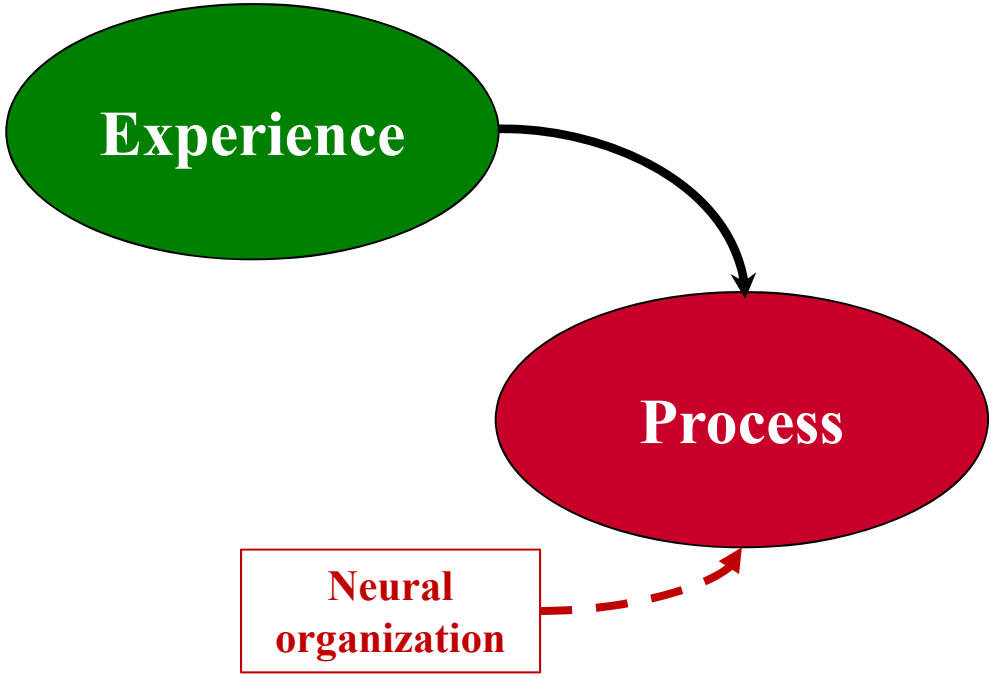
Using The Process (3)

- **The next step is to process the new information.**
- **This is where many students fail in the learning process!**



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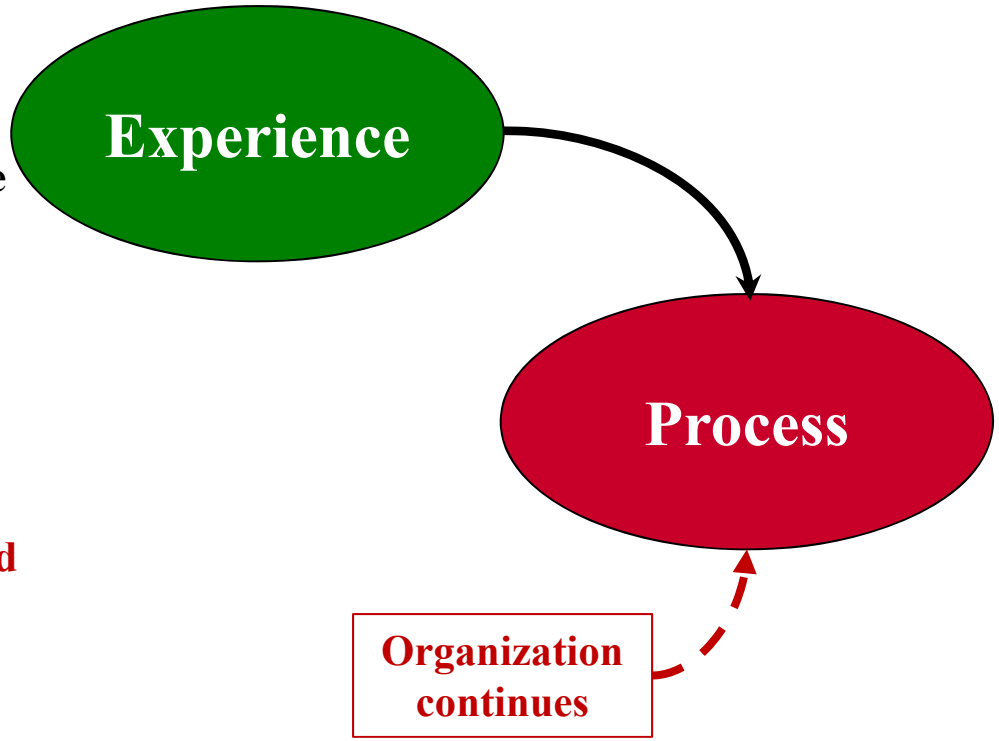
Using The Process (4)

- How to process:
  - Use manageable bits.
- Often this means:
  - Outline the information.
  - Rewrite notes to explain the information.
- These notes should be highly readable (even by others).
- This note reprocessing can improve your grades!
- Remember to ask:
  - What, why, when, where and how (not just facts, but reasons, background, supporting information).



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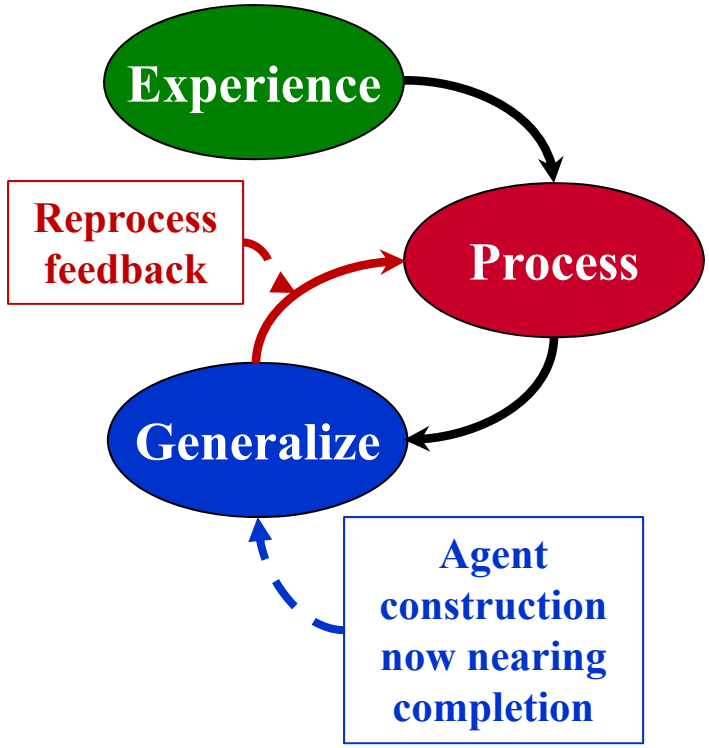
Using The Process (5)

- **Once basic questions are answered, check the fit with other knowledge.**
  - **May need to reprocess (!).**
  - **Examine implications.**
- **Typical outcome**
  - **Less time studying**
  - **Improved grades**



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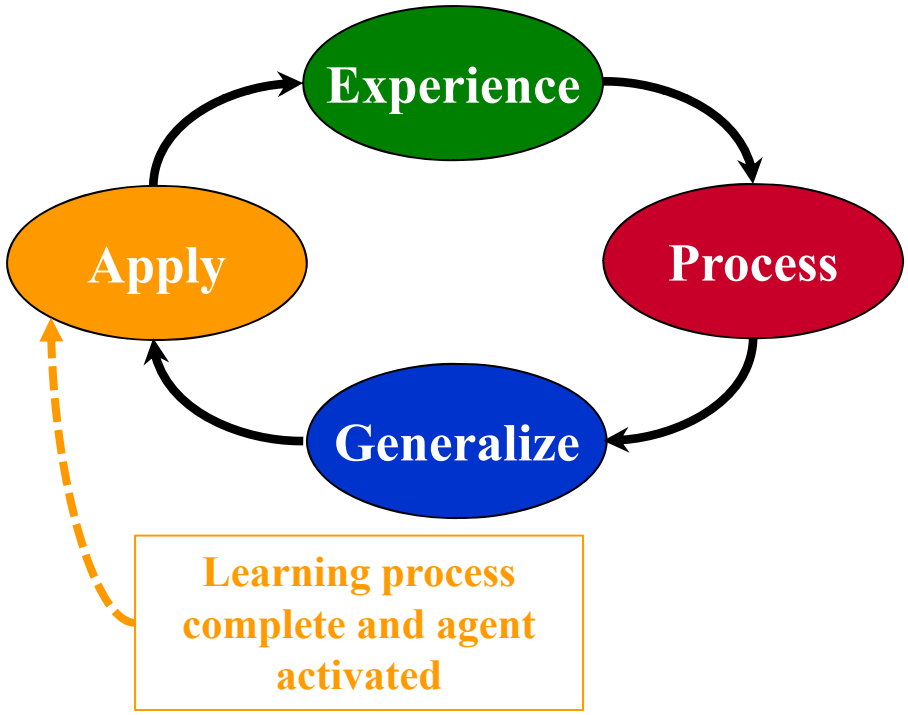
Using The Process (6)

- Now that the generalization is complete ("agent" constructed), you can apply the knowledge'
- Do homework (a new experience!).
- Remember: Each step is important!



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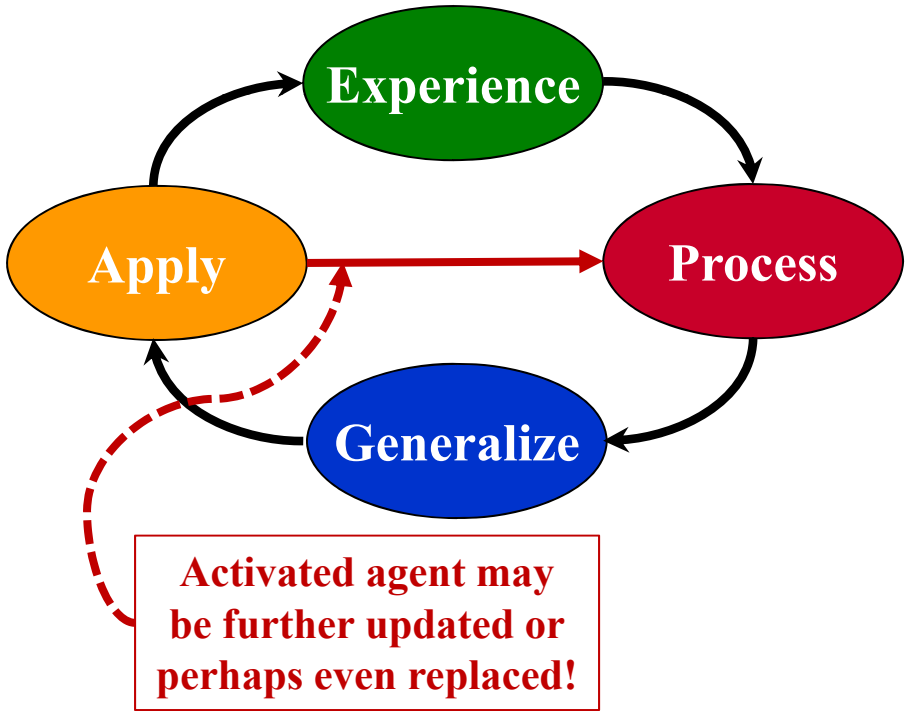
Using The Process (7)

- **Minsky claimed that agents are sometimes updated, sometimes even superseded and replaced.**
- **This implies that a further action (reprocessing/ regeneralizing) in the brain is ongoing even after the agent is fully activated.**
- **Thus even after the "apply" function is activated, our learning process, even related to a current skill or ability, continues.**



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Summary

- **Learning is a sequence of mental steps that can be enhanced by making the processing step more rigorous. That is, you can learn to learn better!**
- **Think of this sequence as "agent building" – a process that programs areas of your brain to develop new skills and deploys them into full activity or use.**
- **Approaching learning with the correct attitude can reinforce your learning ability and also make learning a good deal more interesting and satisfying.**
- **We will use this information when we study homework and how to approach it in Lecture #6.**

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