Learning by Doing:  
First Results on Transfer Learning 

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What is Learning by Doing?

Learning as a result of doing something

Both procedural and non-procedural knowledge such as facts, preferences, and causal theories

Can do useful work (or play) even without complete understanding of domain
Unexpected outcomes create opportunities to learn more about the domain

In a social context one can learn from instruction

One often can transfer procedures from one domain to another
What is Transfer Learning?

Experience

Performance

Transfer Learning Rate Premium

The Domain

Card Games
FLIP(AD)   
MOVE(AD,AU)  
WAIT

AD  AU

CU  CD

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FLIP(AD)   WAIT
MOVE(AD,AU)   WAIT

AD   AU   CU   CD
FLIP(AD)
MOVE(AD,AU)
WAIT
WAIT
FLIP(CD)
MOVE(CD,AD)
FLIP(AD)
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WAIT
FLIP(CD)
MOVE(CD,AD)
FLIP(AD)
MOVE(AD,AU)
WAIT
WAIT
FLIP(CD)
MOVE(CD,AD)
WAIT

NO, MOVE(AD,CD)
WAIT
FLIP(AD)  MOVE(AD,AU)  FLIP(CD)  MOVE(CD,AD)
WAIT                  WAIT                  WAIT
WAIT                  WAIT

NO, MOVE(AD,CD)  WAIT
MOVE(CD,CU)    WAIT

AD     AU     CU     CD

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Learning
Bayesian Model Merging
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FLIP(AD)  WAIT
MOVE(AD,AU)  WAIT

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FLIP(AD)
MOVE(AD,AU)
WAIT
WAIT
FLIP(CD)
MOVE(CD,CU)
DARPATech 05: Learning by Doing. P. Cohen, C. Beal and J. T. Oates, 2005
FLIP(AD)  
MOVE(AD,AU)  
WAIT  
WAIT  
FLIP(CD)  
MOVE(CD,CU)  
WAIT  
WAIT

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DARPATech 05: Learning by Doing. P. Cohen, C. Beal and J. T. Oates, 2005
A  C
FLIP(AD)

A  C
WAIT

A  C
MOVE(AD,AU)

A  C
WAIT

A  C
FLIP(CD)

A  C
WAIT

A  C
MOVE(CD,CU)

A  C
FLIP(AD)

A  C
WAIT

A  C
MOVE(AD,AU)

A  C
WAIT

A  C
FLIP(CD)

A  C
WAIT

A  C
MOVE(CD,CU)

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WAIT
MOVE(AD,AU)

WAIT
FLIP(CD)

WAIT
MOVE(CD,CU)

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DARPATech 05: Learning by Doing. P. Cohen, C. Beal and J. T. Oates, 2005
A
C

MOVE(AD,AU)
FLIP(AD)

A
C

WAIT

A
C

WAIT

A
C

FLIP(CD)

A
C

WAIT

A
C

MOVE(CD,CU)

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Learning

State Splitting
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Experimental Results

Game 1: Take turns turning over cards on separate piles

Game 2: Take turns turning over cards on separate piles, when the cards on the piles match say "Squawk!" as fast as you can

Game 1 by itself was learned in 10 trials
Game 2 by itself was learned in 53 trials
Game 1 followed by Game 2 were learned in 10 + 17 = 27 trials

It took half as long to learn both games as it did to learn Game 2 alone because the finite state machine for Game 1 was transferred to learning Game 2.