Exploring the Impact of Artificial Intelligence: Prediction versus Judgment

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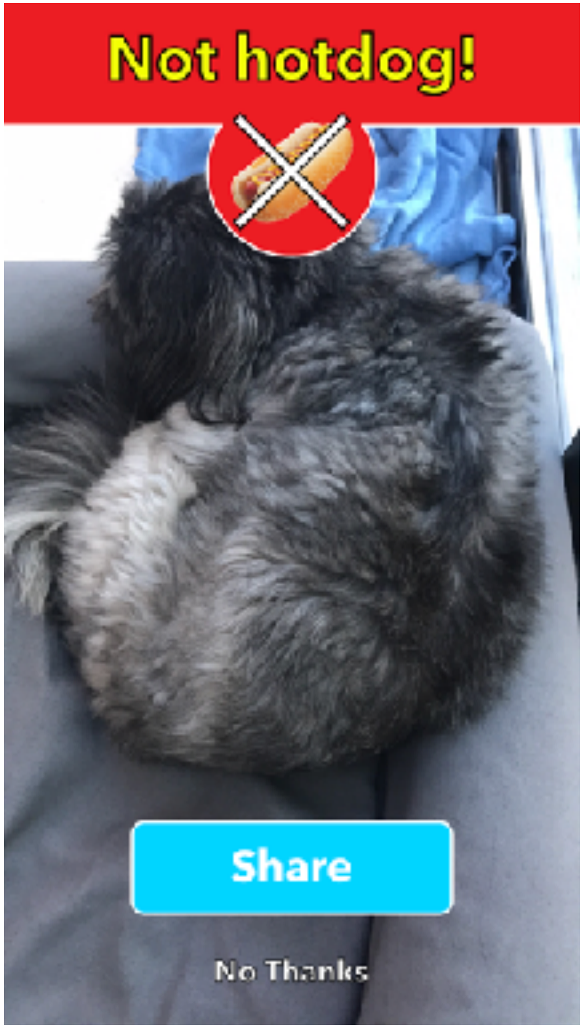
Recent AI is all about **prediction**

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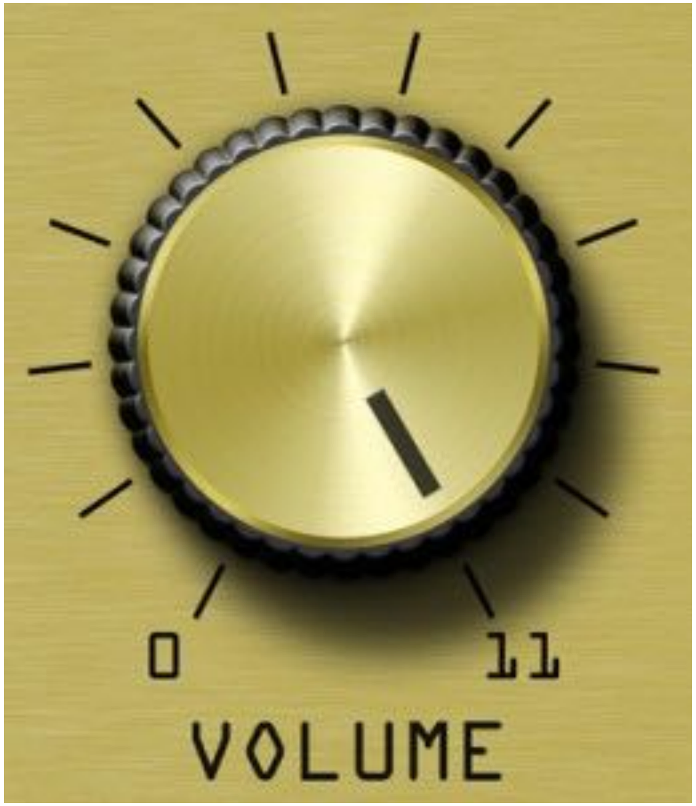
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VOLUME

Recent AI is all about **prediction**

$$\max_{x \in X} \int u(x,\theta)\, dF(\theta \mid s)$$

Root of all worry

Recent AI is all about **prediction**

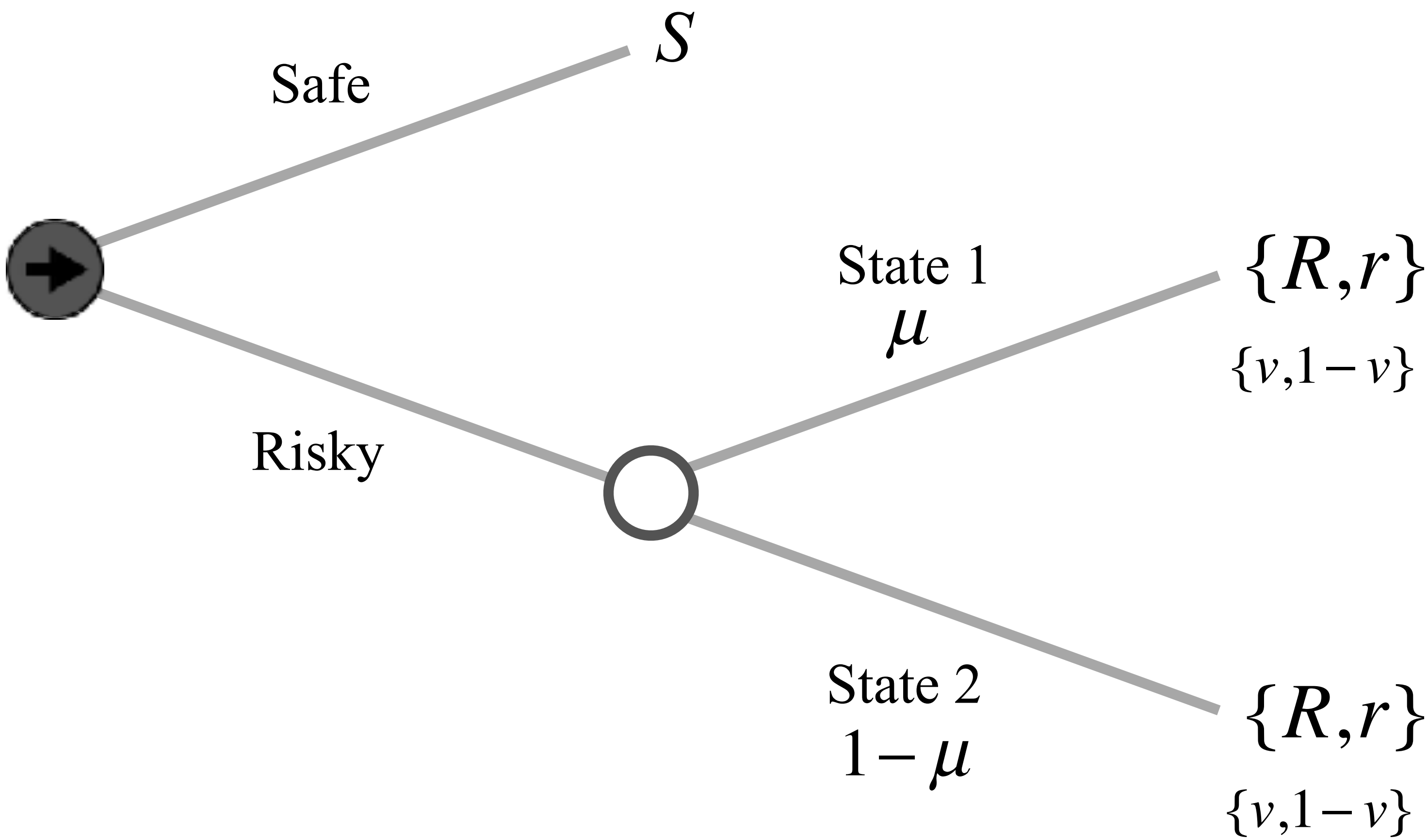
$$\max_{x \in X} \int u(x,\theta)\, dF(\theta | s)$$

Where does this come from?

Thought
Experience
De gustibus non est disputandum

***Judgment** is the process of determining the value of actions in a given state*

$R > S > r$



Bolton & Faure-Grimaud, RES, 2009

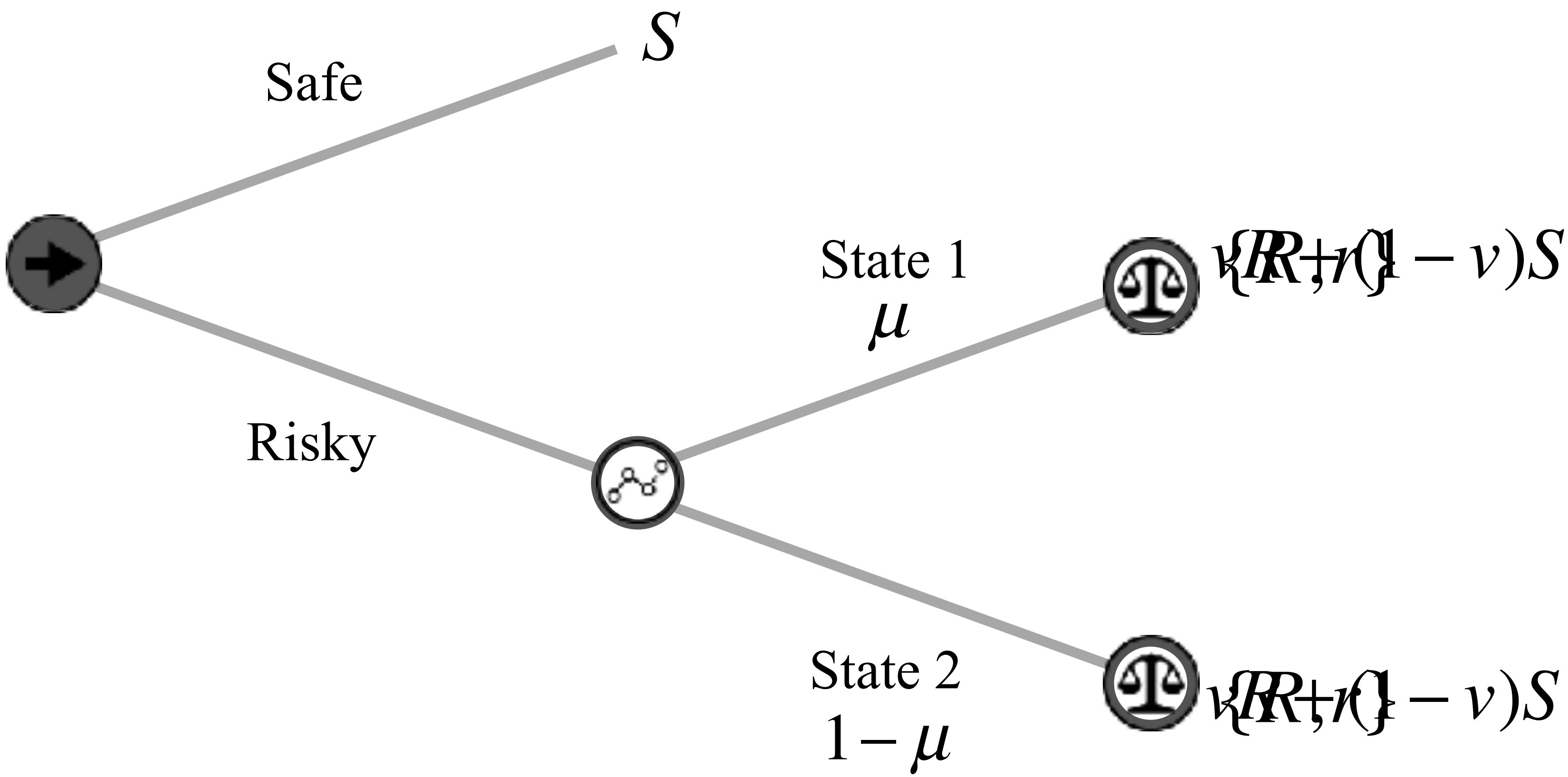
Are prediction and judgment complements or substitutes?

Simple intuition:

- If do not know the payoff, then knowing the state is not valuable
- If do not know the state, then knowing the payoff is not valuable

Complements
(not quite true)

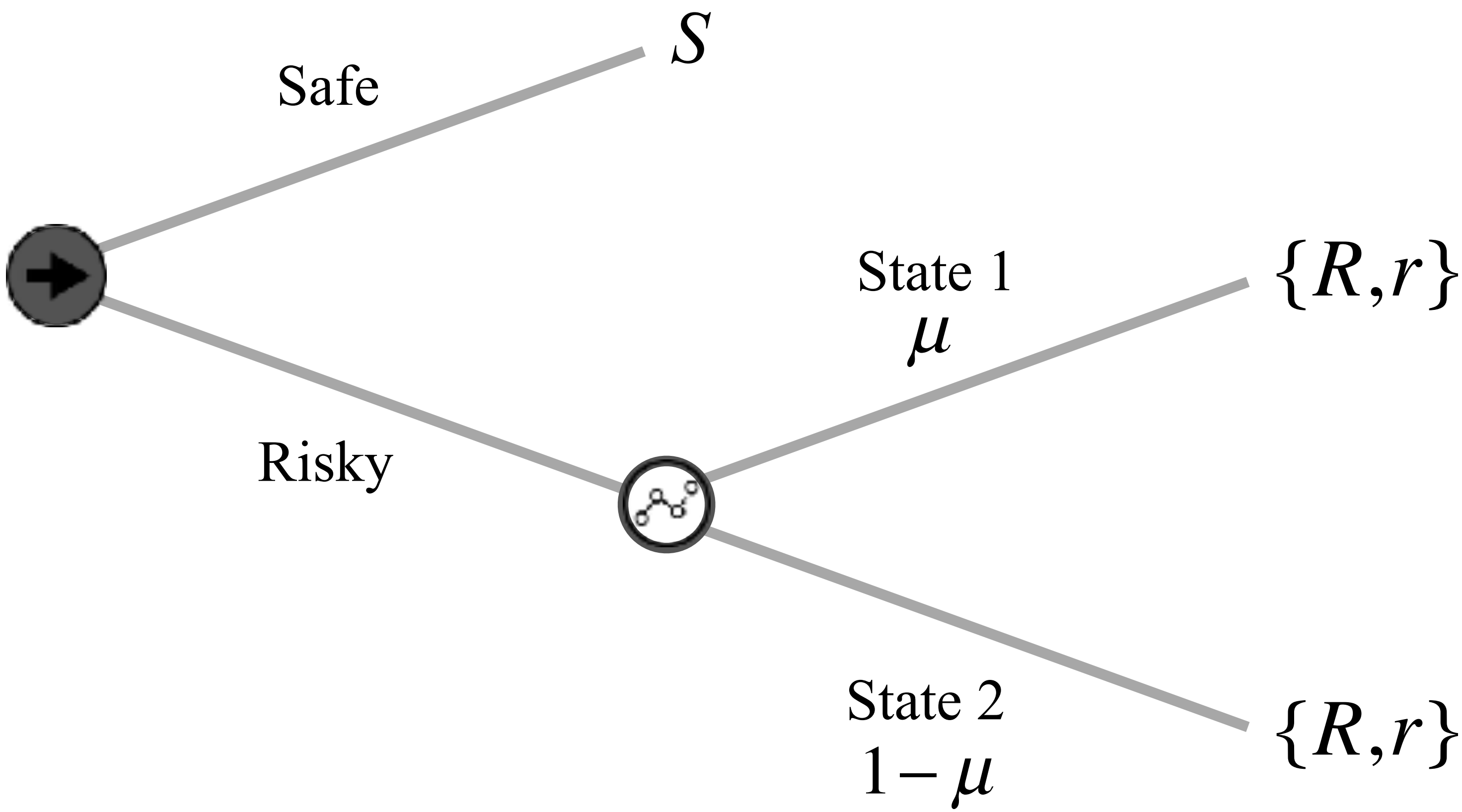
What happens if you have both prediction and judgment?



$$vR + (1 - v)S$$

What is the value of prediction in the absence of judgment?

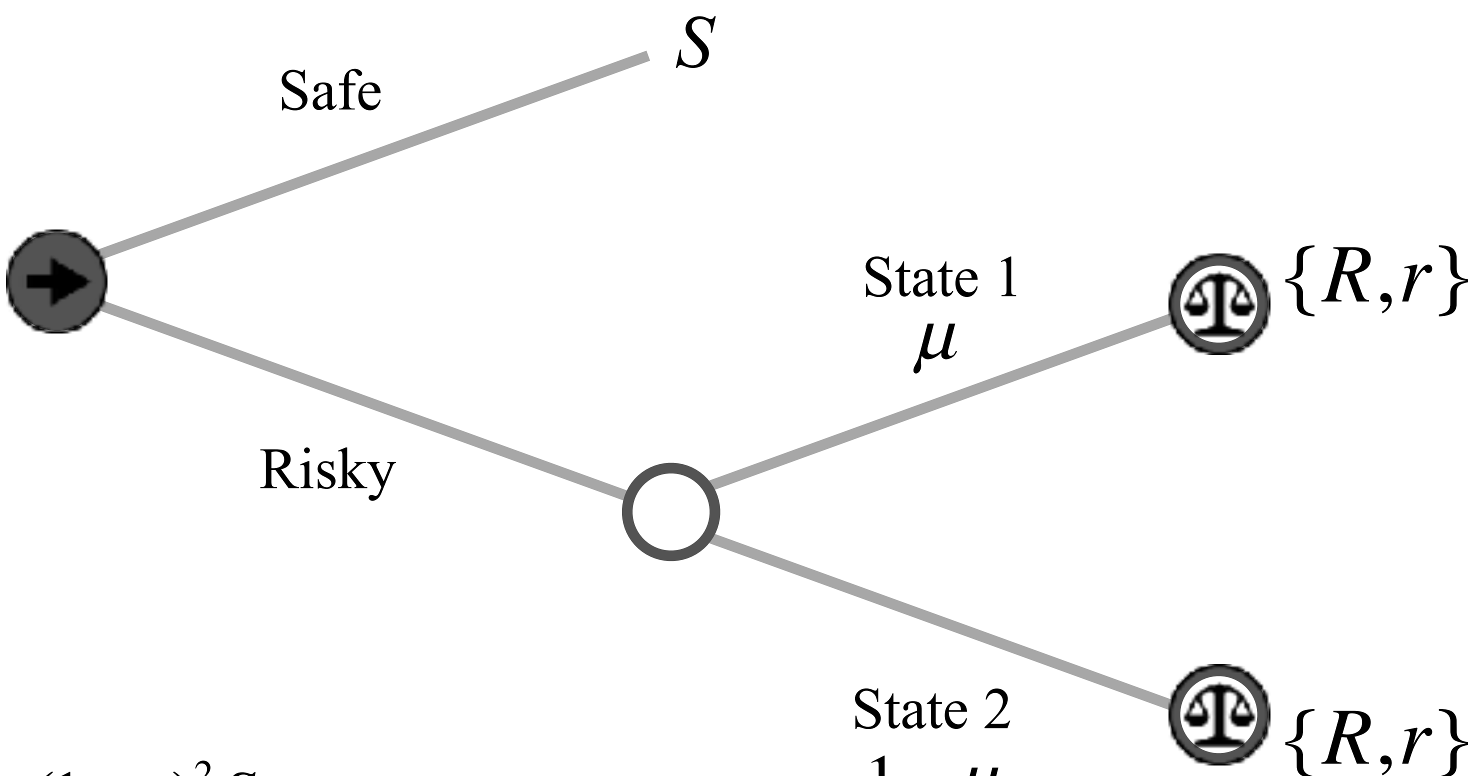
Allows state-contingent decision-making



$$\max\{vR + (1-v)r, S\}$$

What is the value of judgment in the absence of prediction?

Allows identification of dominant actions



$$v^2 R + (1-v)^2 S$$
$$+v(1-v)\max\{\mu R + (1-\mu)r, S\}$$
$$+(1-v)v\max\{\mu r + (1-\mu)R, S\}$$

Judgment as Thought

To work out the payoffs, you need to think (which takes time)

λ learn

$1-\lambda$ don't

λ learn

$1-\lambda$ don't

Apply judgment to state *i*
or
Just choose

Apply judgment to state *j*
or
Just choose

Choose

$$\frac{\lambda}{1-(1-\lambda)\delta} = \hat{\lambda}$$

Bolton & Faure-Grimaud, RES, 2009

Judgment options

	Suppose that (1) safe is a default and (2) judgment alone is insufficient to switch from default	
Learn neither	*Low* $\hat{\lambda}$	
Learn both states	*Dominated*	
Learn one state	*"Medium"* $\hat{\lambda}$	J1
Learn one state and other if 'good' news	*High* $\hat{\lambda}$	J2
Learn one state and other if 'bad' news	*Dominated*	

Learn neither	Learn one state	Learn one state and other if 'good' news

$\hat{\lambda}_{J1}$ $\hat{\lambda}_{J2}$

Prediction Technology

With probability e, perfect forecast, otherwise none

A1 (Safe Default) $vR + (1 - v)r \leq S$

A2 (Judgment Insufficient) $\mu R + (1 - \mu)r \leq S$

$$\mu \geq \tfrac{1}{2}$$

Expected payoff:

$$\pi \equiv e \max\{\hat{\lambda}(vR + (1 - v)S), S\} + (1 - e)\max\{V_{J1}, V_{J2}, S\}$$

Complements or Substitutes?

$$\frac{\partial^2 \pi}{\partial e \partial \lambda} \geq 0 \text{ if } \hat{\lambda} < \hat{\lambda}_{J2}$$

Complements

Substitutes

Learn neither

Learn one state

Learn one state and other if ‘good’ news

$\hat{\lambda}_{J1}$

$\hat{\lambda}_{J2}$

Prediction Reliability

Extensive margin: e is the probability the AI generates a prediction

Intensive margin: a is the probability the AI a generated prediction is correct

Trade-off: if design AI with higher e, a is lower

What happens to design as judgment becomes easier?

e falls and a is higher

Complexity

$$\underbrace{\hat{\lambda}\sum_{i=1}^{m}\mu_i(vR+(1-v)S)}_{\text{Predicted by AI}}+\sum_{i=m+1}^{N}\mu_i S$$

As N increases (m fixed), value of prediction and judgment are reduced

Automation

"Any worker who now performs his task by following specific instructions can, in principle, be replaced by a machine. This means that the role of humans as the most important factor of production is bound to diminish—in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors." Wassily Leontief (1983)

$$\underbrace{\sum_{i=1}^{k}\mu_i(vR+(1-v)S)}_{\text{Automated}}+\underbrace{\hat{\lambda}\sum_{i=1}^{m}\mu_i(vR+(1-v)S)}_{\text{Human Judgment}}+\underbrace{\sum_{i=m+1}^{N}\mu_i S}_{\text{Automated}}$$

As N increases (m fixed), automation increases.

Contracting

$$\underbrace{\sum_{i=1}^{k}\mu_i(vR+(1-v)S)}_{\text{Contractible}}+\underbrace{\hat{\lambda}\sum_{i=1}^{m}\mu_i(vR+(1-v)S)}_{\text{Non-Contractible}}+\underbrace{\sum_{i=m+1}^{N}\mu_i S}_{\text{Contractible}}$$

Firm boundaries

$$\underbrace{\sum_{i=1}^{k}\mu_i(vR+(1-v)S)}_{\text{Outsourced}}+\underbrace{\hat{\lambda}\sum_{i=1}^{m}\mu_i(vR+(1-v)S)}_{\text{Integrated}}+\underbrace{\sum_{i=m+1}^{N}\mu_i S}_{\text{Outsourced}}$$

As m rises, the returns to integration rise.

As k increases, the returns to integration fall.

Tadelis, 2002

Conclusions

AI is about prediction and prediction only

Judgment is the process of determining rewards

Without prediction, judgment can identify dominated actions

Judgment and prediction are complements unless there is a high probability of finding dominated actions

More complex tasks may not be less automated

As prediction improves, contractibility increases but the effects on integration are ambiguous (more for labour but less for capital)