MSiA 410

Creating Business Rules with Predictive Models

Class 4b

Professor Joel Shapiro

Northwestern | McCORMICK SCHOOL OF ENGINEERING

Linking Data Science and Business Decisions

Data Scientists Care About
Confusion Matrix

Actual \ Predicted	-	+
-	TN	FP
+	FN	TP

Business Leaders Care About
Pavoff Matrix

Actual \ Predicted	-	+
-	$Benefit	$Cost
+	$Cost	$Benefit

Data Science → Business Decisions

A business rule should very clearly and unambiguously tell the IT team when to engage in remote rebooting and maintenance.

What information should go into defining a rule? That is, what are the elements / variables in your business rule that need to be fleshed out and/or estimated?

How might you gather the information / variables you laid out in #2, above.

A business rule should very clearly and unambiguously tell the IT team when to engage in remote rebooting and maintenance.

Question: why not do remote repair every day on every tablet?

Assume:

- Each remote reboot / maintenance occurrence costs $100
- SnackAttack loses, on average, $200 for every time that a tablet goes down unexpectedly

If a tablet has a 0.8% chance of failing in the next 12 hours, then is remote maintenance a good idea?

If we do nothing, then the **EXPECTED LOSS** = 0.8% * $200 = **$1.60**
If we do remote maintenance, the cost will be **$100**

Is it worth spending **$100** to save **$1.60?**

A business rule should very clearly and unambiguously tell the IT team when to engage in remote rebooting and maintenance.

$$[p(fail) * \text{cost of failure}] - [\text{cost of remote maintenance}] > 0$$

$$p(fail) > \frac{\text{cost of remote maintenance}}{\text{cost of failure}}$$

A business rule should very clearly and unambiguously tell the IT team when to engage in remote rebooting and maintenance.

[p(fail) * cost of failure] - [cost of remote maintenance] > 0

IF $\longrightarrow$ $p(fail) > \dfrac{\text{cost of remote maintenance}}{\text{cost of failure}}$

THEN $\longrightarrow$ do remote maintenance

A business rule should very clearly and unambiguously tell the IT team when to engage in remote rebooting and maintenance.

$$[p(fail) * \text{cost of failure}] - [\text{cost of remote maintenance}] > 0$$

IF $\longrightarrow$ $p(fail) > \dfrac{\text{cost of remote maintenance}}{\text{cost of failure}}$

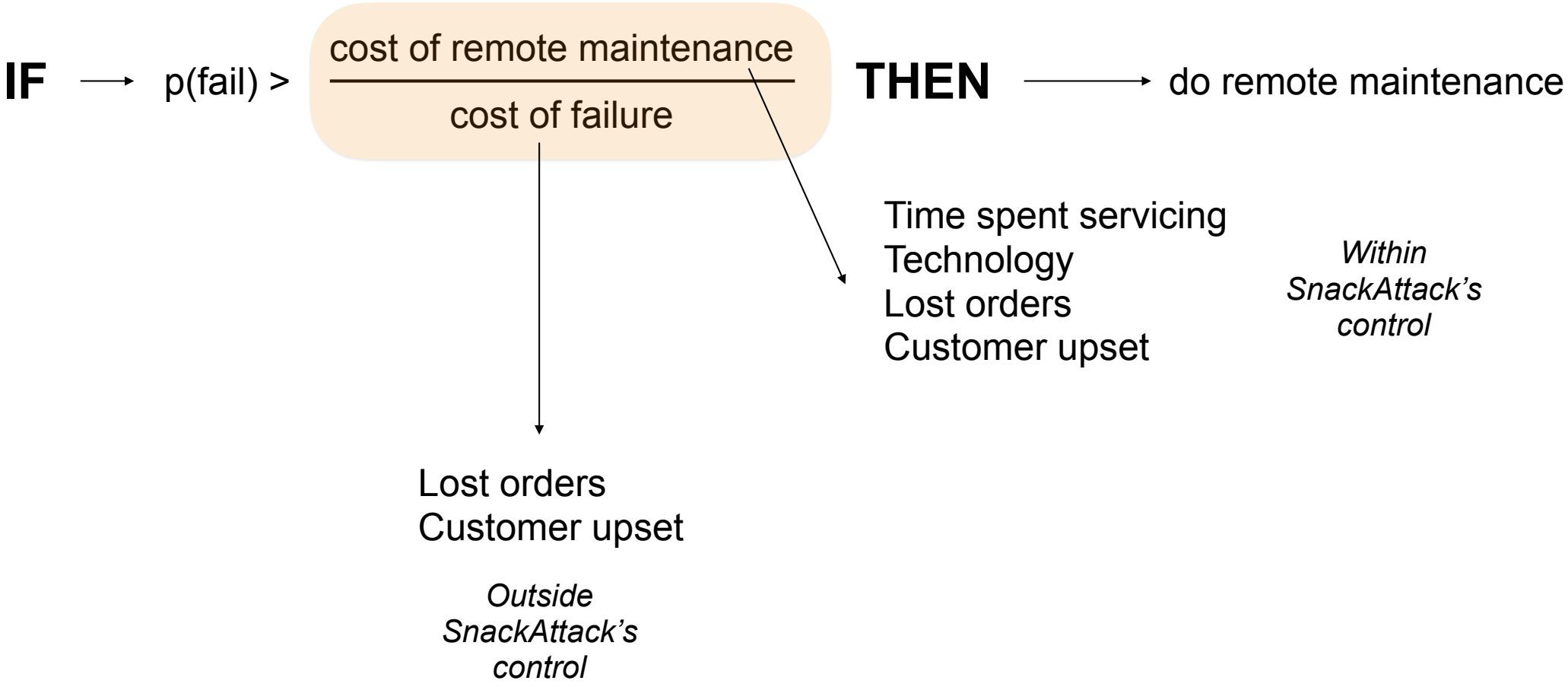
THEN $\longrightarrow$ do remote maintenance

Should SnackAttack do remote maintenance?

- Second Cup's tablet has a 9.2% chance of failing
- Cost of remote maintenance = $18
- Cost of failure = $112

$$0.092 >? \frac{18}{112} = 0.1607$$

What information should go into defining a rule? That is, what are the elements variables in your business rule that need to be fleshed out and/or estimated?



How might you gather the information / variables?

IF → p(fail) > $\frac{\text{cost of remote maintenance}}{\text{cost of failure}}$ **THEN** → do remote maintenance

Time spent servicing
Technology
Lost orders
Customer upset

Within SnackAttack's control

Lost orders
Customer upset

Outside SnackAttack's control

Assumptions needed?

IF $\longrightarrow$ $p(\text{fail}) > \dfrac{\text{cost of remote maintenance}}{\text{cost of failure}}$ **THEN** $\longrightarrow$ do remote maintenance

ASSUMPTIONS

Objective function = “maximize profit”
What if goal was to minimize likelihood of ANY broken tablet? E.g., maximize likelihood that NO tablet breaks?

Costs are all-inclusive
Not just single transaction costs, but customer retention / brand losses

Maintenance absolutely negates potential failure during next 12 hours

Risk neutrality
Most firms are risk averse…

Assumptions needed?

IF $\longrightarrow$ p(fail) > $\dfrac{\text{cost of remote maintenance}}{\text{cost of failure}}$ **THEN** $\longrightarrow$ do remote maintenance

ASSUMPTIONS

Objective function = “maximize profit”
What if goal was to minimize likelihood of ANY broken tablet? E.g., maximize likelihood that NO tablet breaks?

Costs are all-inclusive
Not just single transaction costs, but customer retention / brand losses

Maintenance absolutely negates potential failure during next 12 hours

Risk neutrality
Most firms are risk averse…

p(fail) = .3

c(maintenance) = 40

c(failure) = 100

AUTOMATION OF ***PROCESS***
versus
AUTOMATION OF ***DECISION***

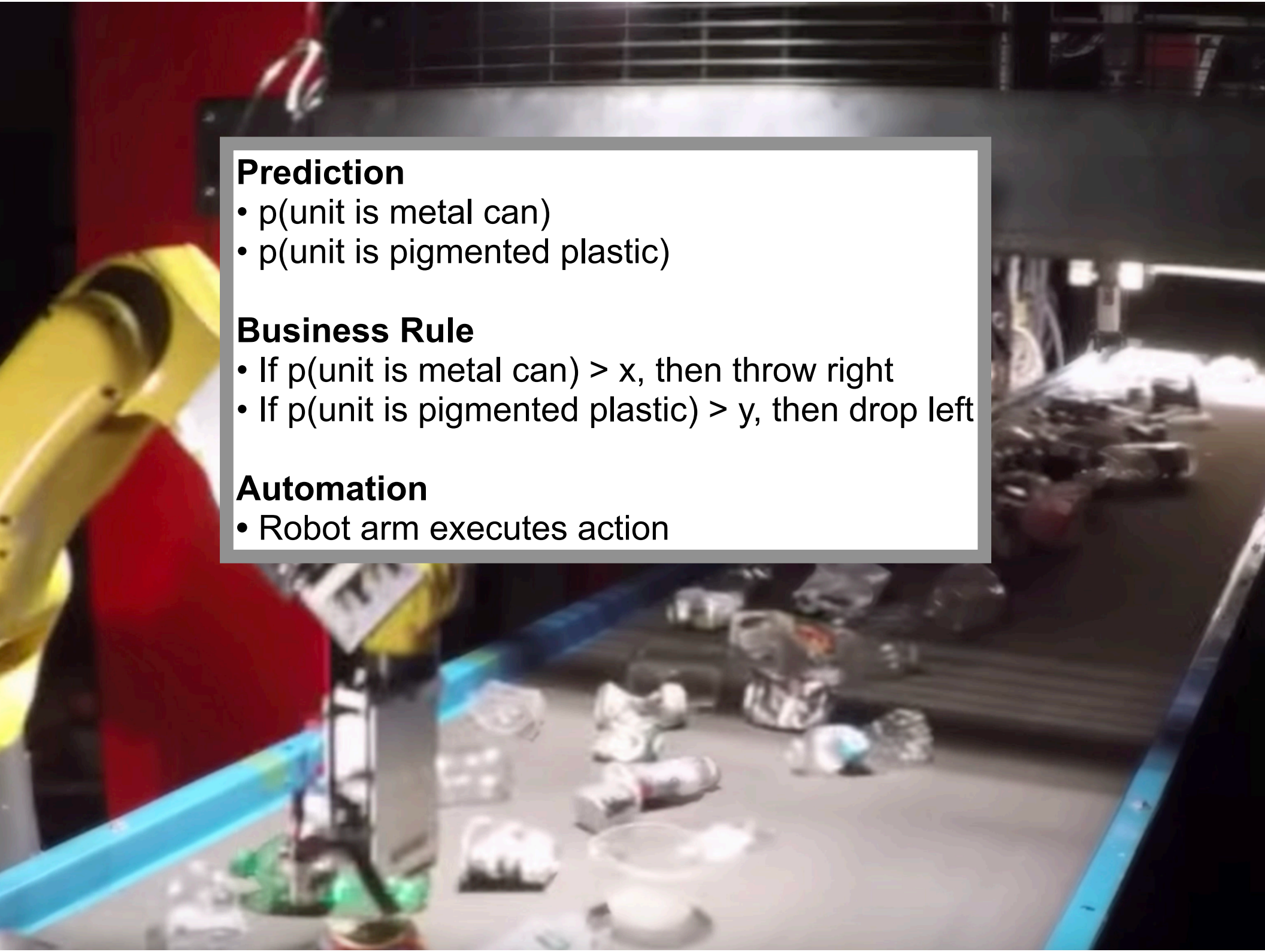
AUTOMATION OF ***PROCESS***
versus
AUTOMATION OF ***DECISION***

AUTOMATION OF PROCESS

Execution of tasks without human intervention

AUTOMATION OF DECISION

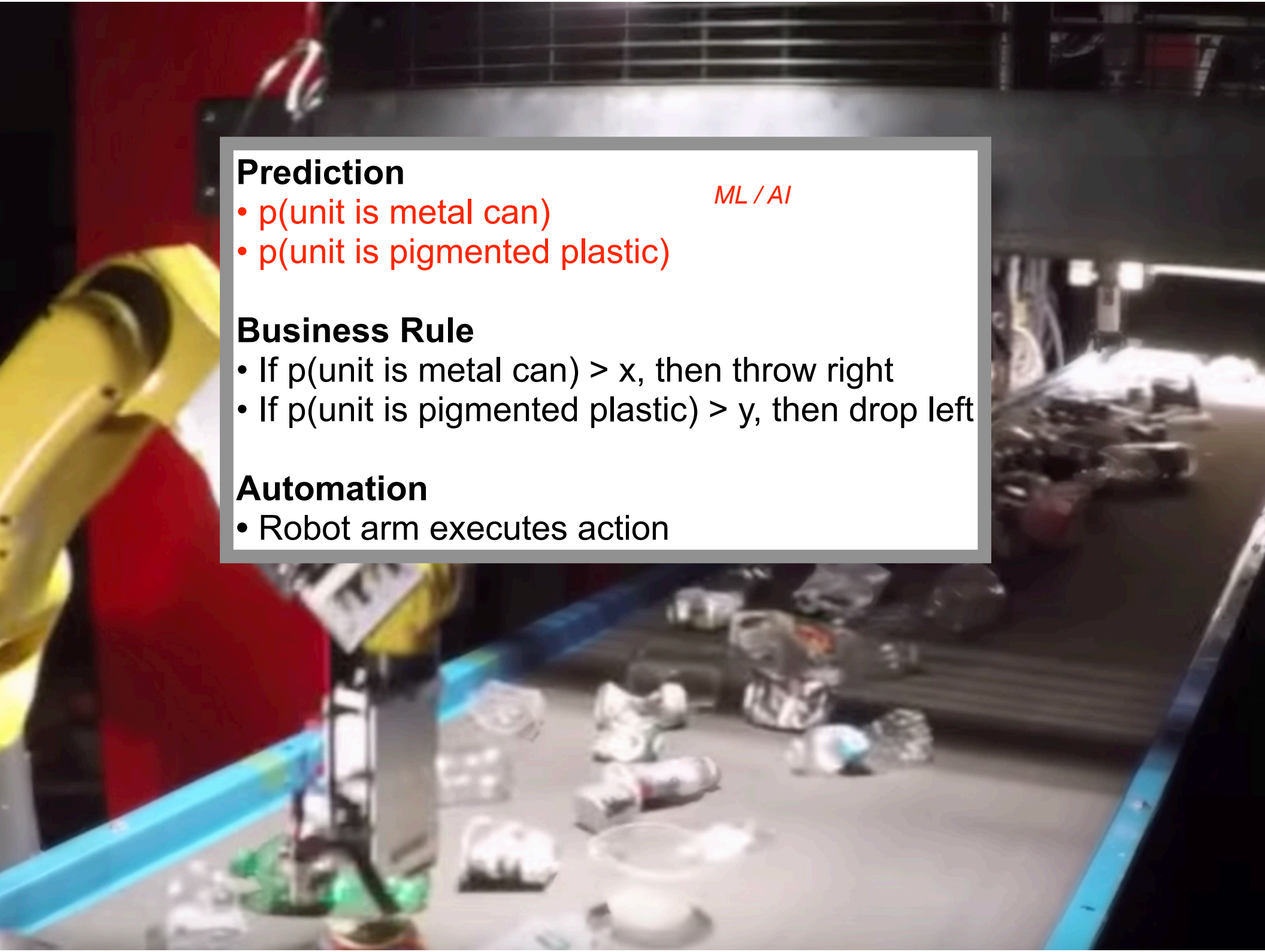
Determination of action without human intervention

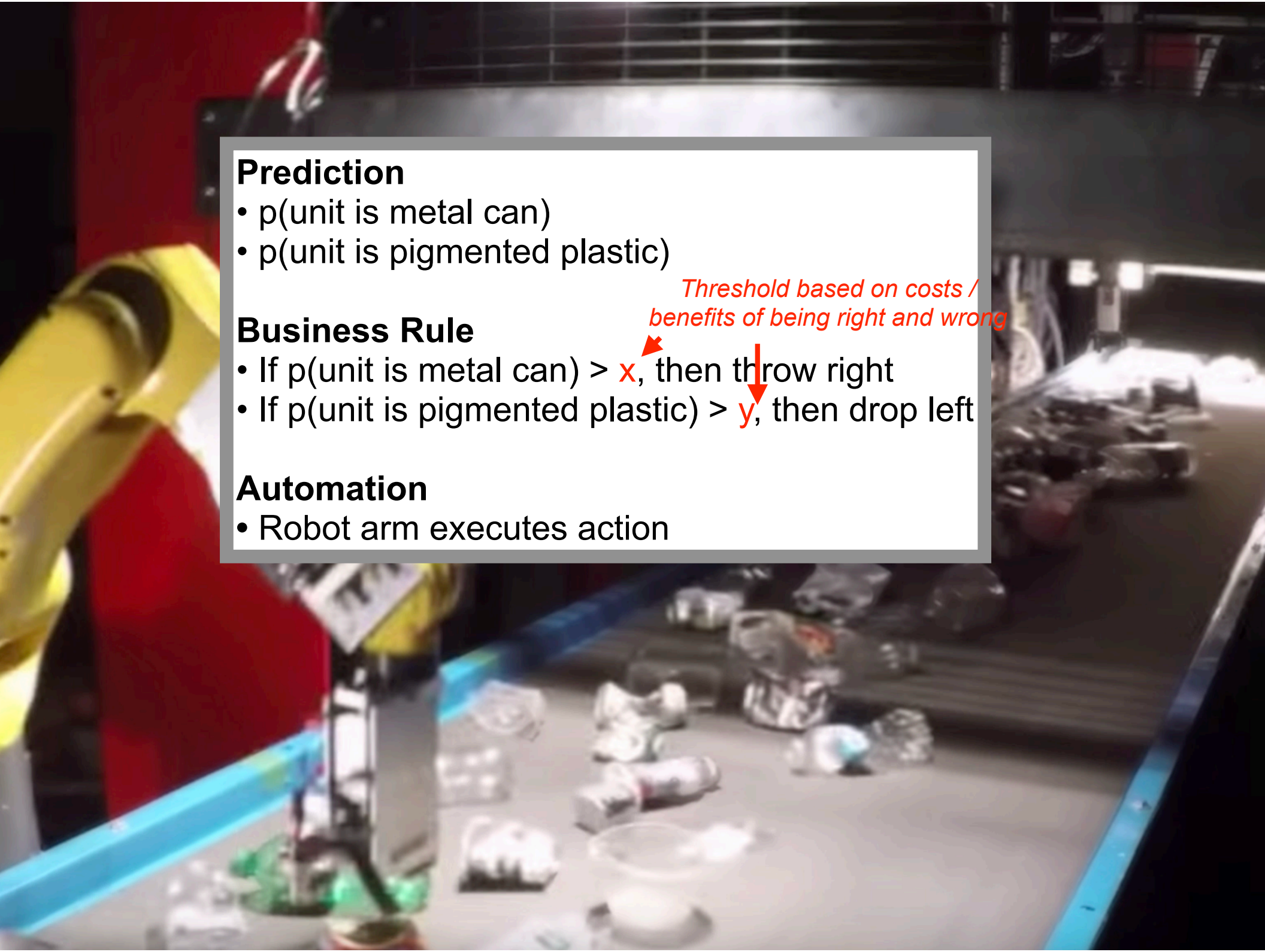


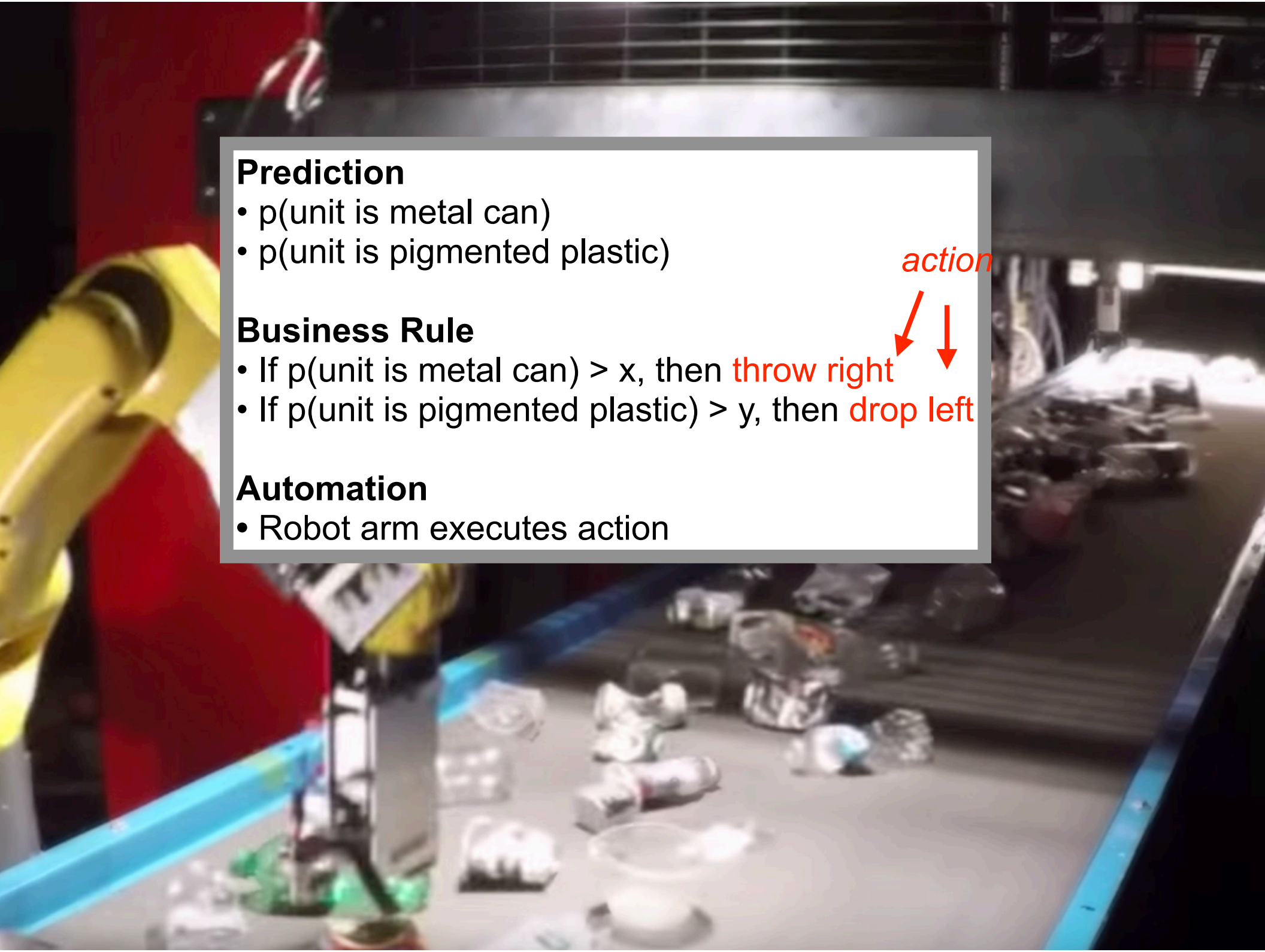
Prediction
- p(unit is metal can)
- p(unit is pigmented plastic)

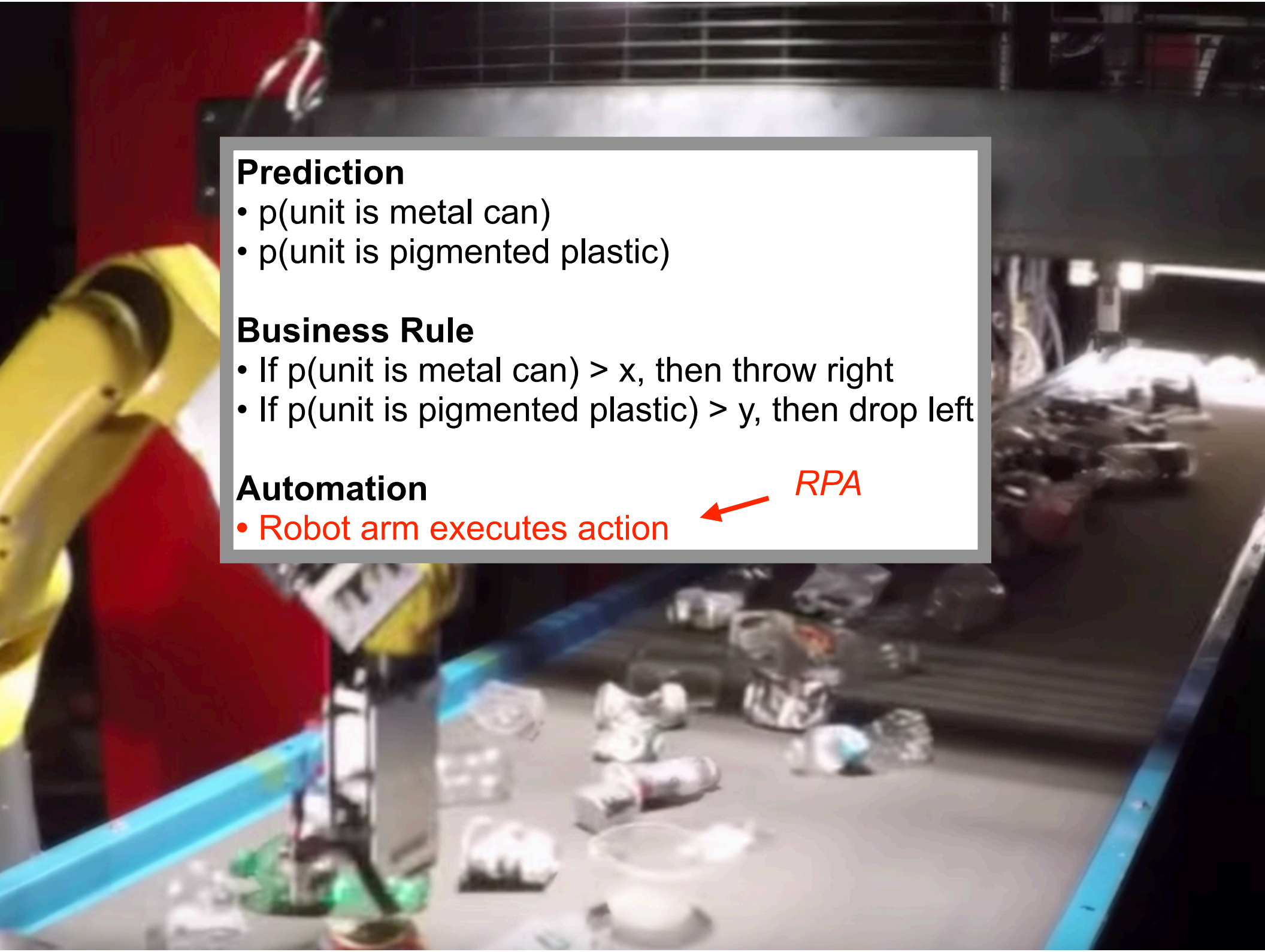
Business Rule
- If p(unit is metal can) > x, then throw right
- If p(unit is pigmented plastic) > y, then drop left

Automation
- Robot arm executes action


Prediction
ML / AI
• p(unit is metal can)
• p(unit is pigmented plastic)
Business Rule
• If p(unit is metal can) > x, then throw right
• If p(unit is pigmented plastic) > y, then drop left
Automation
• Robot arm executes action


Prediction
• p(unit is metal can)
• p(unit is pigmented plastic)
Threshold based on costs / benefits of being right and wrong
Business Rule
• If p(unit is metal can) > x, then throw right
• If p(unit is pigmented plastic) > y, then drop left
Automation
• Robot arm executes action


Prediction
• p(unit is metal can)
• p(unit is pigmented plastic)
action
Business Rule
• If p(unit is metal can) > x, then throw right
• If p(unit is pigmented plastic) > y, then drop left
Automation
• Robot arm executes action


Prediction
• p(unit is metal can)
• p(unit is pigmented plastic)
Business Rule
• If p(unit is metal can) > x, then throw right
• If p(unit is pigmented plastic) > y, then drop left
Automation
• Robot arm executes action
RPA

AUTOMATION OF ***PROCESS***
versus
AUTOMATION OF ***DECISION***

AUTOMATION OF PROCESS

Execution of tasks without human intervention

AUTOMATION OF DECISION

Determination of action without human intervention

IF → p(fail) > $\frac{\text{cost of remote maintenance}}{\text{cost of failure}}$ **THEN** → do remote maintenance

AUTOMATION OF ***PROCESS***
versus
AUTOMATION OF ***DECISION***

AUTOMATION OF PROCESS

Execution of tasks without human intervention

AUTOMATION OF DECISION

Determination of action without human intervention

Simple criterion-based decisions ⟷ More difficult, multi-layered decisions

IF → p(fail) > $\frac{\text{cost of remote maintenance}}{\text{cost of failure}}$ **THEN** → do remote maintenance