* Basic quantity derived from persasility of particular event occurring from a 3.v.

INFORMATION

CONTENT | SELF - INFORMATION (I)

INFORMATION * Basic quantity derived from persasility of particular event according from a sivi

CONTENT (SELF - INFORMATION (I)

information

2 MOIRA E *

i) Event with 1001. Jeussacility yields no

CONTENT | SELF - INFORMATION (I) INFORMATION * Basic quantity derived from personality of particular event according from a sivi

2 AMOMS

i) Event with 1001. Jeussasility yields no information

2) hers pussable the event, more informat it

CONTENT | SELF - INFORMATION (I) INFORMATION * Basic quantity derived from personsity of particular event occurring from a sivi 2 MOINA & * 1) Event with 10011. Joubability yields no information

2) hers pursable the event, more informat it

3) If 2 independent events are measured separately, total information is sum of self-information individual events

CONTENT (SELF - INFORMATION (I) INFORMATION $I(x) = -\log_b \left[\operatorname{Per}(x) \right] = -\log_b P$ b = 2, I(n) unit = sham non b = 2, I(n) unit = NAT2 MOIRA E * 1) Event with 1001. Jeustability yields no information 2) here pussable the event, more informat it 3) If 2 independent events are measured separately, total information is sum of self-information events

CONTENT | SELF - INFORMATION (I) INFORMATION $I(x) = -\log_b \left[\Pr(x) \right] = -\log_b P$ Event x w/ probability P 111 ADHERES TO ALL LAWS * 3 AMONS i) Event with 1001. Journalitity yields no information

2) here pussable the event, more informat it 3) If 2 independent events are measured separately, total information is sum of self-information individual events

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_L(x) \right] = -\log_b P$$
Evert x w) probability P

11 ADHERES TO ALL LAWS

1) Event with 1001. Joubability yields no information

Event with 100% puebability $I(x) = -\log_2 Pr(1) = 0$

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_4(x) \right] = -\log_b P$$
Event $x \in V$ probability P

$$P(x) = 0$$

$$\Rightarrow I(x) = -\log_2(0) \rightarrow \infty$$

INFORMATION (ONTENT | SELF - INFORMATION (I) $I(x) = -\log_b \left[P_4(x) \right] = -\log_b P$ Event x w | probability P

3) If 2 independent events are measured separately, total information is sum of self-information events

2 Independent r.v. X, Y with pmfs Px(m), Py(y)

JOINT PM7 PX, Y (X, Y) = Px(X). Py(Y)

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_u(x) \right] = -\log_b P$$
Event $x w$ | probability P

2 Independent
$$A \cdot v \cdot X, Y$$
 with $pmfs P_X(x), P_Y(y)$

JOINT PMF $P_{X,Y}(x,y) = P_X(x), P_Y(y)$
 $I_{X,Y}(x,y) = -log[P_{XY}(x=x,Y=y)] = -log_{2}P_{X}(x) - log_{2}P_{X}(y)$
 $= I_{X}(x) + I_{Y}(y)$

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_u(x) \right] = -\log_b P$$
Event $x w$ probability P

 $I_X(H) = -log_2 pr(H) = -log_2(\frac{1}{2}) = 1 shanron$

INFORMATION (ON TENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_L(x) \right] = -\log_b P$$
Event $x w$ | probability P

Example: FAIR TOSS (OIN)
$$P_X(n) = P_X(T) = 0.5$$

$$P_{K}(H) = P_{X}(T) = 0.5$$

$$I_{X}(H) = -log_{2}P_{X}(H) = -log_{2}(\frac{1}{2}) = l shanron$$

$$I_{x}(H) = -\log_{2}(0.9) = 0.15; I_{x}(T) = -\log_{2}(0.1) = 2.321$$

INFORMATION CONTENT (SELF - INFORMATION (I) $I(x) = -\log_b \left[\operatorname{Per}(x) \right] = -\log_b P$ Event $x w \mid \text{probability } P$

Ix, y (x=4, y=2) =?

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_u(x) \right] = -\log_b P$$
Event $x w$ | probability P

$$I_{x,y} (x=4,y=2) = ?$$

$$= I_{x}(x=y) + I_{y}(y=z)$$

$$= -\log_{2}(\frac{1}{6}) - \log_{2}(\frac{1}{6})$$

INFORMATION CONTENT (SELF - INFORMATION (I) $I(x) = -\log_b \left[P_u(x) \right] = -\log_b P$ Event $x w \mid \text{pussability } P$

x, y ~ Disceete Uniform [1,6] Ix, y (x=4, y=2) =?

= Jxy (x= 4, Y= 2) = - log 2 (-1 g)

= 5.169 Shannons

INFORMATION (ONTENT | SELF - INFORMATION (I)

$$I(x) = -\log_b \left[P_u(x) \right] = -\log_b P$$
Event $x w$ | probability P

$$P_{x}(k) = \begin{cases} P_{i}; & k = s_{i} \in S \\ 0; & olw \end{cases}$$

$$S = \begin{cases} S_{i} = S_{i} \\ S_{i} = S_{i} \end{cases} = Suppost$$

 $I_{\times}(\pi) = -\log_2 p_{\times}(\pi)$

* Basic quantity in Information Theory

* Interpreted as overage level of information!

Surprise

* H(X) = E[Jx]

* Basic quantity in Information Theory

* Interpreted as overage level of information/

Surprise

* H(X) = E[IX]

Example: FAIR TOSS (OIN) $P_{K}(H) = P_{X}(T) = 0.5$ $I_{X}(T) = I_{X}(H) = -\log_{2} P_{X}(H) = -\log_{2} \left(\frac{1}{2}\right) = 1 \text{ shannon}$

 $H(x) = \rho_x(x) * I_x(x) + \rho_x(x) * I_x(x) = 1$

* Basic quantity in Information Theory

* Interpreted as overage level of information!

Surprise

* H(X) = E[1x]

 $= \sum_{i} P_{x}(x_{i}) I_{x}(x_{i})$ = - \(\bar{\chi} \bar

ON Z-Px: log fx:

$$H(X) = -\sum_{i} P_{x}(x_{i}) \log_{b} P_{x}(x_{i})$$

- Temp.

Play

N 0

Cotoset

round yes

-
$$pres log_2 f / es$$
= $-\frac{1}{2}log_2 \frac{1}{2} - \frac{1}{2}log_2 \frac{1}{2}$

- Pno log z tuo

ENTROPY CONDITIONAL

ENTROPY of Y GINEN X * CONDITIONA 2

7, 7 are support for X and X

* CONDITIONA 2

DERIVATION .

H(Y|X) = - =

zer, yef

H(Y |X=x) = Entropy of Y conditioned on X= x

- Z P(Y=y |X= x) log P(Y=y|X=x) y & y

ENTROPY CONDITIONAL

$$H(Y|X) = -\frac{1}{2} P(x,y) \log \frac{P(x,y)}{P(x)}$$

PERIVATION .

$$H(Y|X=x) = Entropy of Y conditioned on X= x$$

$$= - = P(Y=y|X=x) log P(Y=y|X=x)$$

- Z P(Y=y | X= Z) log P(Y=y|X=X)
YEY

INTORMATION

CON 7 ENT

- Z P(Y=y |X=z) log P(Y=y|X=z) y ∈ y

: H(Y|X) = E P(x) H(Y|X=x)

CONDITIONAL

H(Y |X=x) = Entropy of Y conditioned on X= 2

== (x | x) = = = p(x) H (y | x=x)

ENTROPY



= E P(x) Z P(y) x) log P(y)x)

REX YEY

- \(\text{P(Y=y | X= \(\text{X}) log P(Y=y | X= \(\text{X}) \)} \)

ENTROPY CONDITIONAL

H(Y |X=x) = Entropy of Y conditioned on X= x

$$H(Y|X=x) = Extrapy of results of P(Y=y|X=x)$$

$$= - \sum_{y \in Y} P(Y=y|X=x) \log_{y} P(Y=y|X=x)$$

: H(Y|X) =
$$\mathbb{Z}$$
 $P(x)$ H(Y|X= x)
 $\mathbb{Z} \in \mathcal{X}$
 $= -\mathbb{Z}$ $P(x)$ \mathbb{Z} $P(y|x)$ $\log P(y|x)$

=-E P(N) Z P(yla) log P(yla)

REX YEY - E E P(x,y) log P(y)x)

ENTROPY CONDITIONAL

DERIVATION . H(Y |X=x) = Entropy of Y conditioned on X= x

- Z P(Y=y |X=z) log P(Y=y|X=z) y & y

== (x | x) = = = p(x) H (y | x=x)

H (YIX) = - = E P(7,4) Rog (4(7)) H

=-E P(N) Z P(y) Nog P(y) x)

REX YEY

- E E P(x,x) de P(y)x)
x = x × x = x

H (Y)X) = H (X,Y) - H (X)

= +(x,y) + \(\nable \text{p(x)log+(x)}

H(X,Y) + = (= P(7/8)) log P(7/))

GUTROPY AND CONDITIONA L Cotoset Play - Temp. - pro log 2 + 100 H (Play) = - Hot N 0 - pres logz pres 0.0 Hot round yes -1 log 1 -1 log 1 H (Play 1 Temp) =

INFORMATION GAIN

GUTROPK AND CONDITIONA L Dofoset Play - Temp. H (Play) = - pro 609 2 + 100 - Hot N 0 - pres logz tyes N 2 · Hot Normal Yes -1 log 1 -1 log 1 $H(Y|X) = \sum_{x \in X} p(x) H(Y|X=x)$ P(Temp= Hot) H(Play | Temp= Hot) +
P(Temp= Cold) H(Play | Temp= Cold) + ...
P(Temp= Normal) H(Play | Temp= Normal) =) H (Ply 1 Temp) =

INFORMATION GAIN

GUTROPK AND CONDITIONA L Cotoset Play - Temp. H (Play) = - pro log 2 + 100 - Hot No - free logz fres 1 00 Hot rounal yes -1 log_ 1 -1 log_ 1 ON Play (7) having observed INTO. GAIN Entropy (Play) - Entropy (Y IX) Temp (x) =

INFORMATION GAIN