Question 1

$(p|q|-r)\&((-r|q|p)->((r|q)\&-q\&-p))$

$$
\begin{array}{rl}
 & (p \lor q \lor \neg r) \land ((\neg r \lor q \lor p) \Rightarrow ((r \lor q) \land \neg q \land \neg p)) \\
\mathrm{I} & (p \lor q \lor \neg r) \land (\neg(\neg r \lor q \lor p) \lor ((r \lor q) \land \neg q \land \neg p)) \\
\mathrm{N} & (p \lor q \lor \neg r) \land ((r \land \neg q \land \neg p) \lor ((r \lor q) \land \neg q \land \neg p)) \\
\mathrm{D} & (p \lor q \lor \neg r) \land (((r \land \neg q \land \neg p) \lor (r \lor q)) \land (((r \land \neg q \land \neg p) \lor \neg q)) \land (((r \land \neg q \land \neg p) \lor \neg p))) \\
\mathrm{D} & (p \lor q \lor \neg r) \land (((r \lor r \lor q) \land (\neg q \lor r \lor q) \land (\neg p \lor r \lor q) \\
 & \land (r \lor \neg q) \land (\neg q \lor \neg q) \land (\neg p \lor \neg q) \land (r \lor \neg p) \land (\neg q \lor \neg p) \land (\neg p \lor \neg p))) \\
\mathrm{O} & \\
1 & \{p, q, \neg r\} \\
2 & \{r, q\} \\
3 & \{\neg q, r, q\} \\
4 & \{\neg p, r, q\} \\
5 & \{r, \neg q\} \\
6 & \{\neg q\} \\
7 & \{\neg p, \neg q\} \\
8 & \{r, \neg p\} \\
9 & \{\neg q, \neg p\} \\
10 & \{\neg p\} \\
\text{Resolution} & \\
11 & \{p, q\} \\
12 & \{p\} \\
13 & \{\}
\end{array}
$$

Question 2

$\forall x \forall y(Horse(x) \land Dog(y) \Rightarrow Faster(x, y))$
$\exists g(Greyhound(g) \land \forall r(Rabbit(r) \Rightarrow Faster(g, r)))$
$\forall x \forall r(Horse(x) \land Rabbit(r) \Rightarrow Faster(x, r))$
neg conclusion: $\neg(\forall x \forall r(Horse(x) \land Rabbit(r) \Rightarrow Faster(x, r)))$
Now turn them to clausal form and do the resolution steps.

$$\begin{array}{ll}
 & \forall x \forall y(\mathrm{Horse}(x) \wedge \mathrm{Dog}(y) \Rightarrow \mathrm{Faster}(x, y)) \\
\mathrm{I} & \forall x \forall y(\neg((\mathrm{Horse}(x) \wedge \mathrm{Dog}(y)) \vee \mathrm{Faster}(x, y)) \\
\mathrm{N} & \forall x \forall y(\neg \mathrm{Horse}(x) \vee \neg \mathrm{Dog}(y) \vee \mathrm{Faster}(x, y)) \\
\mathrm{E} & \neg \mathrm{Horse}(x) \vee \neg \mathrm{Dog}(y) \vee \mathrm{Faster}(x, y) \\
\mathrm{O} & \{\neg \mathrm{Horse}(x), \neg \mathrm{Dog}(y), \mathrm{Faster}(x, y)\}
\end{array}$$

$$\begin{array}{ll}
 & \exists g(\mathrm{Greyhound}(g) \wedge \forall r(\mathrm{Rabbit}(r) \Rightarrow \mathrm{Faster}(g, r))) \\
\mathrm{I} & \exists g(\mathrm{Greyhound}(g) \wedge \forall r(\neg \mathrm{Rabbit}(r) \vee \mathrm{Faster}(g, r))) \\
\mathrm{E} & \exists g(\mathrm{Greyhound}(g) \wedge (\neg \mathrm{Rabbit}(r) \vee \mathrm{Faster}(g, r))) \\
\mathrm{A} & \mathrm{Greyhound}(\mathrm{Grey}) \wedge (\neg \mathrm{Rabbit}(r) \vee \mathrm{Faster}(\mathrm{Grey}, r))) \\
\mathrm{O} & \{\mathrm{Greyhound}(\mathrm{Grey})\} \\
 & \{\neg \mathrm{Rabbit}(r), \mathrm{Faster}(\mathrm{Grey}, r)\}
\end{array}$$

Conclusion:

$$\begin{array}{ll}
 & \neg(\forall x \forall r(\mathrm{Horse}(x) \wedge \mathrm{Rabbit}(r) \Rightarrow \mathrm{Faster}(x, r))) \\
\mathrm{I} & \neg(\forall x \forall r(\neg((\mathrm{Horse}(x) \wedge \mathrm{Rabbit}(r)) \vee \mathrm{Faster}(x, r))) \\
\mathrm{N} & \neg(\forall x \forall r(\neg \mathrm{Horse}(x) \vee \neg \mathrm{Rabbit}(r) \vee \mathrm{Faster}(x, r))) \\
\mathrm{N} & \exists x \exists r \neg(\neg \mathrm{Horse}(x) \vee \neg \mathrm{Rabbit}(r) \vee \mathrm{Faster}(x, r))) \\
\mathrm{N} & \exists x \exists r(\mathrm{Horse}(x) \wedge \mathrm{Rabbit}(r) \wedge \neg \mathrm{Faster}(x, r)) \\
\mathrm{A} & \mathrm{Horse}(\mathrm{Happy}) \wedge \mathrm{Rabbit}(\mathrm{Rein}) \wedge \neg \mathrm{Faster}(\mathrm{Happy}, \mathrm{Rein}) \\
\mathrm{O} & \{\mathrm{Horse}(\mathrm{Happy})\} \\
 & \{\mathrm{Rabbit}(\mathrm{Rein})\} \\
 & \{\neg \mathrm{Faster}(\mathrm{Happy}, \mathrm{Rein})\}
\end{array}$$

And the backgroud knowledge:
$\forall g(\mathrm{Greyghound}(g) \Rightarrow \mathrm{Dog}(g))$

$\forall x \forall y \forall z (Faster(x, y) \wedge Faster(y, z) \Rightarrow Faster(x, z))$

	$\forall g (Greyghound(g) \Rightarrow Dog(g))$
I	$\forall g \neg Greyghound(g) \vee Dog(g))$
A	$\neg Greyghound(g) \vee Dog(g))$
O	$\{\neg Greyghound(g), Dog(g)\}$

	$\forall x \forall y \forall z (Faster(x, y) \wedge Faster(y, z) \Rightarrow Faster(x, z))$
I	$x \forall y \forall z (\neg (Faster(x, y) \wedge Faster(y, z)) \vee Faster(x, z))$
N	$\forall y \forall z (\neg Faster(x, y) \vee \neg Faster(y, z) \vee Faster(x, z))$
A	$\neg Faster(x, y) \vee \neg Faster(y, z) \vee Faster(x, z)$
O	$\{\neg Faster(x, y), \neg Faster(y, z), Faster(x, z)\}$

Resolution:

1	$\{\neg Horse(x_1), \neg Dog(y_1), Faster(x_1, y_1)\}$	
2	$\{Greyhound(Grey)\}$	
3	$\{\neg Rabbit(r_1), Faster(Grey, r_1)\}$	
4	$\{\neg Greyghound(g_1), Dog(g_1)\}$	
5	$\{\neg Faster(x_2, y_2), \neg Faster(y_2, z_1), Faster(x_2, z_1)\}$	
6	$\{Horse(Happy)\}$	
7	$\{Rabbit(Rein)\}$	
8	$\{\neg Faster(Happy, Rein)\}$	
9	$\{Dog(Grey)\}$	$2, 4$
10	$\{Faster(Grey, Rein)\}$	$3, 7$
11	$\{\neg Horse(x_1), Faster(x_1, Grey)\}$	$1, 9$
12	$\{Faster(Happy, Grey)\}$	$6, 11$
13	$\{\neg Faster(Grey, z_1), Faster(Happy, z_1)\}$	$5, 12$
14	$\{Faster(Happy, Rein)\}$	$10, 13$
15	$\{\}$	$8, 14$

Question 3

$\forall x(Hummingbird(x) \Rightarrow Richcolor(x))$
$\neg\exists y(Bird(y) \wedge Large(y) \wedge LiveonHon(y))$
$\forall y(Bird(y) \wedge \neg LiveonHon(y) \Rightarrow \neg Richcolor(y))$
$\forall x(Hummingbird(x) \Rightarrow Bird(x))$ (Background)
$\forall x(Hummingbird(x) \Rightarrow \neg Large(x))$ (Conlusion)

Prover 9:

$1 (all x (hummingbird(x) -> richcolor(x))) [assumption].$
$2 (all x - (bird(x) \& large(x) \& liveonhon(x))) [assumption].$
$3 (all x (bird(x) \& - liveonhon(x) -> -richcolor(x))) [assumption].$
$4 (all x (hummingbird(x) -> bird(x))) [assumption].$
$5 (all x (hummingbird(x) -> -large(x))) [goal].$
$6 hummingbird(c1). [deny(5)].$
$7 - hummingbird(x) | richcolor(x). [clausify(1)].$
$8 - hummingbird(x) | bird(x). [clausify(4)].$
$9 bird(c1). [resolve(6, a, 8, a)].$
$10 - bird(x) | - large(x) | - liveonhon(x). [clausify(2)].$
$11 - bird(x) | liveonhon(x) | - richcolor(x). [clausify(3)].$
$12 - large(c1) | - liveonhon(c1). [resolve(9, a, 10, a)].$
$13 large(c1). [deny(5)].$
$14 liveonhon(c1) | - richcolor(c1). [resolve(9, a, 11, a)].$
$15 richcolor(c1). [resolve(6, a, 7, a)].$
$16 liveonhon(c1). [resolve(14, b, 15, a)].$
$17 - liveonhon(c1). [resolve(12, a, 13, a)].$
$18 \$F. [resolve(16, a, 17, a)].$

Question 4

mg = My gardener; wl = worth listening to on military subjects;
ar = able to remember the battle of waterloo; old=very old

$\exists x (person(x) \land mg(x) \land wl(x)).$
$\forall y ((person(y) \land ar(y)) \Rightarrow old(y)).$
$\forall z ((person(z) \land wl(z)) \Rightarrow ar(z)).$
$\exists m (person(x) \land mg(m) \land old(m)). (conclusion)$

Prover 9:

$1 (exists x (person(x) \& mg(x) \& wl(x))) [assumption].$
$2 (all x (person(x) \& ar(x) -> old(x))) [assumption].$
$3 (all x (person(x) \& wl(x) -> ar(x))) [assumption].$
$4 (exists m (person(m) \& mg(m) \& old(m))) [goal].$
$5 -person(x) | -ar(x) | old(x). [clausify(2)].$
$6 person(c1). [clausify(1)].$
$7 -person(x) | -wl(x) | ar(x). [clausify(3)].$
$8 -person(x) | -mg(x) | -old(x). [deny(4)].$
$9 -mg(c1) | -old(c1). [resolve(8, a, 6, a)].$
$10 mg(c1). [clausify(1)].$
$11 -wl(c1) | ar(c1). [resolve(7, a, 6, a)].$
$12 wl(c1). [clausify(1)].$
$13 ar(c1). [resolve(11, a, 12, a)].$
$14 -ar(c1) | old(c1). [resolve(5, a, 6, a)].$
$15 old(c1). [resolve(13, a, 14, a)].$
$16 -old(c1). [resolve(9, a, 10, a)].$
$17 \$F. [resolve(15, a, 16, a)].$

Question 5

$P(P_{13}) = P(P_{22}) = P(P_{31}) = 0.01$

$$\begin{aligned}
P(p_{13}|b_{12}, b_{21}) &= \alpha \sum_{p_{22}} \sum_{p_{31}} (P(b_{12}|p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(p_{31})) \\
&= \alpha[P(b_{12}|p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|p_{13}, \neg p_{22}) \cdot P(b_{21}|\neg p_{22}, p_{31}) \cdot P(p_{13}) \cdot P(\neg p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, \neg p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(\neg p_{31}) + \\
&P(b_{12}p_{13}, p_{22}) \cdot P(b_{21}|\neg p_{22}, \neg p_{31}) \cdot P(p_{13}) \cdot P(\neg p_{22}) \cdot P(\neg p_{31})] \\
&= \alpha[1 \cdot 1 \cdot 0.01 \cdot 0.01 \cdot 0.01 + 1 \cdot 1 \cdot 0.01 \cdot 0.99 \cdot 0.01 + \\
&1 \cdot 1 \cdot 0.01 \cdot 0.01 \cdot 0.99 + 0] = \alpha(0.000001 + 0.000099 + 0.000099) \\
&= 0.000199\alpha
\end{aligned}$$

$$\begin{aligned}
P(\neg p_{13}|b_{12}, b_{21}) &= \alpha \sum_{p_{22}} \sum_{p_{31}} (P(b_{12}|\neg p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, p_{31}) \cdot P(\neg p_{13}) \cdot P(p_{22}) \cdot P(p_{31})) \\
&= \alpha[P(b_{12}|\neg p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, p_{31}) \cdot P(\neg p_{13}) \cdot P(p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|\neg p_{13}, \neg p_{22}) \cdot P(b_{21}|\neg p_{22}, p_{31}) \cdot P(\neg p_{13}) \cdot P(\neg p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|\neg p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, \neg p_{31}) \cdot P(\neg p_{13}) \cdot P(p_{22}) \cdot P(\neg p_{31}) + \\
&P(b_{12}|\neg p_{13}, p_{22}) \cdot P(b_{21}|\neg p_{22}, \neg p_{31}) \cdot P(\neg p_{13}) \cdot P(\neg p_{22}) \cdot P(\neg p_{31})] \\
&= \alpha[1 \cdot 1 \cdot 0.99 \cdot 0.01 \cdot 0.01 + 0 + 1 \cdot 1 \cdot 0.99 \cdot 0.01 \cdot 0.99 + 0) \\
&= \alpha(0.000099 + 0.009801) = 0.0099\alpha
\end{aligned}$$

$$\begin{aligned}
\alpha &= 1/(0.000199 + 0.0099) = 99.02 \\
P(p_{13}|b_{12}, b_{21}) &= 0.0197 \\
P(\neg p_{13}|b_{12}, b_{21}) &= 0.9803
\end{aligned}$$

$$\begin{aligned}
P(p_{31}|b_{12}, b_{21}) &= \alpha \sum_{p_{13}} \sum_{p_{22}} (P(b_{12}|p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(p_{31})) \\
&= 0.0197 \\
P(\neg p_{31}|b_{12}, b_{21}) &= \alpha \sum_{p_{13}} \sum_{p_{22}} (P(b_{12}|p_{13}, p_{22}) \cdot P(b_{21}|p_{22}, \neg p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(\neg p_{31})) \\
&= 0.9803
\end{aligned}$$

$$
\begin{aligned}
P(p_{22}|b_{12},b_{21}) &= \alpha \sum_{p_{13}} \sum_{p_{31}} (P(b_{12}|p_{13},p_{22}) \cdot P(b_{21}|p_{22},p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(p_{31})) \\
&= \alpha[P(b_{12}|p_{13},p_{22}) \cdot P(b_{21}|p_{22},p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|\neg p_{13},p_{22}) \cdot P(b_{21}|p_{22},p_{31}) \cdot P(\neg p_{13}) \cdot P(p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|p_{13},p_{22}) \cdot P(b_{21}|p_{22},\neg p_{31}) \cdot P(p_{13}) \cdot P(p_{22}) \cdot P(\neg p_{31}) + \\
&P(b_{12}|\neg p_{13},p_{22}) \cdot P(b_{21}|p_{22},\neg p_{31}) \cdot P(\neg p_{13}) \cdot P(p_{22}) \cdot P(\neg p_{31})] \\
&= \alpha(1 \cdot 1 \cdot 0.01 \cdot 0.01 \cdot 0.01 + 1 \cdot 1 \cdot 0.01 \cdot 0.01 \cdot 0.99 \\
&+ 1 \cdot 1 \cdot 0.01 \cdot 0.01 \cdot 0.99 + 1 \cdot 1 \cdot 0.99 \cdot 0.01 \cdot 0.99) \\
&= 0.01\alpha
\end{aligned}
$$

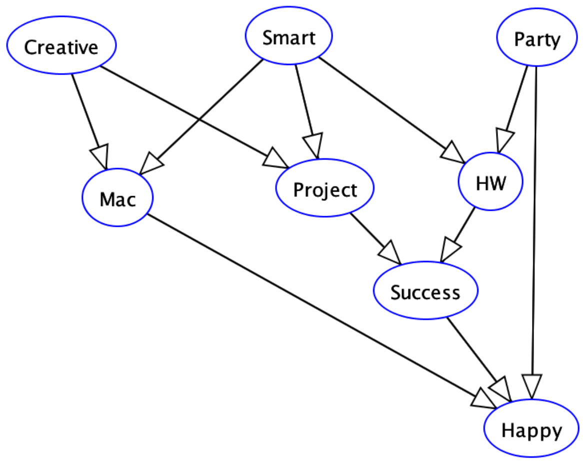
$$
\begin{aligned}
P(\neg p_{22}|b_{12},b_{21}) &= \alpha \sum_{p_{13}} \sum_{p_{31}} (P(b_{12}|p_{13},\neg p_{22}) \cdot P(b_{21}|\neg p_{22},p_{31}) \cdot P(p_{13}) \cdot P(\neg p_{22}) \cdot P(p_{31})) \\
&= \alpha[P(b_{12}|p_{13},\neg p_{22}) \cdot P(b_{21}|\neg p_{22},p_{31}) \cdot P(p_{13}) \cdot P(\neg p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|\neg p_{13},\neg p_{22}) \cdot P(b_{21}|\neg p_{22},p_{31}) \cdot P(\neg p_{13}) \cdot P(\neg p_{22}) \cdot P(p_{31}) + \\
&P(b_{12}|p_{13},\neg p_{22}) \cdot P(b_{21}|\neg p_{22},\neg p_{31}) \cdot P(p_{13}) \cdot P(\neg p_{22}) \cdot P(\neg p_{31}) + \\
&P(b_{12}|\neg p_{13},\neg p_{22}) \cdot P(b_{21}|\neg p_{22},\neg p_{31}) \cdot P(\neg p_{13}) \cdot P(\neg p_{22}) \cdot P(\neg p_{31})] \\
&= \alpha(1 \cdot 1 \cdot 0.01 \cdot 0.99 \cdot 0.01 + 0 + 0 + 0) = 0.000099\alpha
\end{aligned}
$$

$$
\begin{aligned}
\alpha &= 1/(0.01 + 0.000099) = 99.02 \\
P(p_{22}|b_{12},b_{21}) &= 0.9902 \\
P(\neg p_{22}|b_{12},b_{21}) &= 0.0098
\end{aligned}
$$

Going to [2,2] is almost certain death. So, a probabilistic agent will never choose to go to [2,2]. On the other hand, to a logical agent, squares [1,3], [2,2], [3,1] look the same. So, the logical agent would choose either one with equal chance (1/3). By doing that, the agent will die with a chance of about 1/3.

Question 6

1



2

<table>
<tr><th>Party</th><th>Smart</th><th>P(HW|Party,Smart)</th><th></th><th></th></tr>
<tr><td>T</td><td>T</td><td>1722</td><td>2145</td><td>0.8027972</td></tr>
<tr><td>T</td><td>F</td><td>81</td><td>866</td><td>0.0935335</td></tr>
<tr><td>F</td><td>T</td><td>1239</td><td>1379</td><td>0.8984772</td></tr>
<tr><td>F</td><td>F</td><td>186</td><td>610</td><td>0.304918</td></tr>
</table>

<table>
<tr><th>Smart</th><th>Creative</th><th>P(Mac|Smart, Creative)</th><th></th><th></th></tr>
<tr><td>T</td><td>T</td><td>1685</td><td>2457</td><td>0.68579569</td></tr>
<tr><td>T</td><td>F</td><td>441</td><td>1067</td><td>0.41330834</td></tr>
<tr><td>F</td><td>T</td><td>933</td><td>1040</td><td>0.89711538</td></tr>
<tr><td>F</td><td>F</td><td>53</td><td>436</td><td>0.12155963</td></tr>
</table>

<table>
<tr><th>Success</th><th>Mac</th><th>Party</th><th>P(Happy|Success,Mac,Party)</th><th></th><th></th></tr>
<tr><td>T</td><td>T</td><td>T</td><td>921</td><td>960</td><td>0.959375</td></tr>
<tr><td>T</td><td>T</td><td>F</td><td>271</td><td>757</td><td>0.3579921</td></tr>
<tr><td>T</td><td>F</td><td>T</td><td>456</td><td>632</td><td>0.721519</td></tr>
<tr><td>F</td><td>T</td><td>T</td><td>449</td><td>912</td><td>0.4923246</td></tr>
<tr><td>T</td><td>F</td><td>F</td><td>135</td><td>440</td><td>0.3068182</td></tr>
<tr><td>F</td><td>T</td><td>F</td><td>99</td><td>483</td><td>0.2049689</td></tr>
<tr><td>F</td><td>F</td><td>T</td><td>213</td><td>507</td><td>0.4201183</td></tr>
<tr><td>F</td><td>F</td><td>F</td><td>29</td><td>309</td><td>0.0938511</td></tr>
</table>

<table>
<tr><th>Smart</th><th>Creative</th><th>P(Project|Smart, Creative)</th><th></th><th></th></tr>
<tr><td>T</td><td>T</td><td>2224</td><td>2457</td><td>0.9051689</td></tr>
<tr><td>T</td><td>F</td><td>847</td><td>1067</td><td>0.7938144</td></tr>
<tr><td>F</td><td>T</td><td>419</td><td>1040</td><td>0.4028846</td></tr>
<tr><td>F</td><td>F</td><td>46</td><td>436</td><td>0.1055046</td></tr>
</table>

<table>
<tr><th>HW</th><th>Project</th><th>P(Success|HW, Project)</th><th></th><th></th></tr>
<tr><td>T</td><td>T</td><td>2394</td><td>2670</td><td>0.89662921</td></tr>
<tr><td>T</td><td>F</td><td>171</td><td>558</td><td>0.30645161</td></tr>
<tr><td>F</td><td>T</td><td>179</td><td>866</td><td>0.20669746</td></tr>
<tr><td>F</td><td>F</td><td>45</td><td>906</td><td>0.04966887</td></tr>
</table>

<table>
<tr><th>Party</th><th></th><th></th><th>P(Party)</th></tr>
<tr><td>T</td><td>3011</td><td>5000</td><td>0.6022</td></tr>
<tr><td>Smart</td><td></td><td></td><td>P(Smart)</td></tr>
<tr><td>T</td><td>3524</td><td>5000</td><td>0.7048</td></tr>
<tr><td>Creative</td><td></td><td></td><td>P(Creative)</td></tr>
<tr><td>T</td><td>3497</td><td>5000</td><td>0.6994</td></tr>
</table>

3

$$
\begin{aligned}
&P(happy|party, smart, \neg creative) \\
&= \alpha \sum_{mac} \sum_{project} \sum_{hw} \sum_{success} [P(happy, mac, success, hw, project, party, smart, \neg creative)] \\
&= \alpha \sum_{mac} \sum_{project} \sum_{hw} \sum_{success} [P(happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(success|project, hw) \cdot P(hw|party, smart) \cdot P(project|\neg creative, smart) \cdot \\
&P(party) \cdot P(smart) \cdot P(\neg creative)] \\
&= \alpha P(party) \cdot P(smart) \cdot P(\neg creative) \cdot \sum_{project} \cdot P(project|\neg creative, smart) \\
&\sum_{mac} \sum_{hw} \sum_{success} P(happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(success|project, hw) \cdot P(hw|party, smart) \\
&= \alpha P(party) \cdot P(smart) \cdot P(\neg creative) \cdot \sum_{project} \cdot P(project|\neg creative, smart) \\
&[P(happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(success|project, hw) \cdot P(hw|party, smart) + \\
&P(happy|\neg mac, success, party) \cdot P(\neg mac|\neg creative, smart) \cdot \\
&P(success|project, hw) \cdot P(hw|party, smart) + \\
&P(happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(success|project, \neg hw) \cdot P(\neg hw|party, smart) + \\
&P(happy|mac, \neg success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(\neg success|project, hw) \cdot P(hw|party, smart) + \\
&P(happy|\neg mac, \neg success, party) \cdot P(\neg mac|\neg creative, smart) \cdot \\
&P(\neg success|project, hw) \cdot P(hw|party, smart) + \\
&P(happy|\neg mac, success, party) \cdot P(\neg mac|\neg creative, smart) \cdot \\
&P(success|project, \neg hw) \cdot P(\neg hw|party, smart) + \\
&P(happy|mac, \neg success, party) \cdot P(mac|\neg creative, smart) \cdot \\
&P(\neg success|project, \neg hw) \cdot P(\neg hw|party, smart) + \\
&P(happy|\neg mac, \neg success, party) \cdot P(\neg mac|\neg creative, smart) \cdot \\
&P(\neg success|project, \neg hw) \cdot P(\neg hw|party, smart)] \\
&= 0.692
\end{aligned}
$$

$$P(\neg happy|party, smart, \neg creative)$$
$$= \alpha \sum_{mac} \sum_{project} \sum_{hw} \sum_{success} [P(\neg happy, mac, success, hw, project, party, smart, \neg creative)]$$
$$= \alpha \sum_{mac} \sum_{project} \sum_{hw} \sum_{success} [P(\neg happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(success|project, hw) \cdot P(hw|party, smart) \cdot P(project|\neg creative, smart) \cdot$$
$$P(party) \cdot P(smart) \cdot P(\neg creative)]$$
$$= \alpha P(party) \cdot P(smart) \cdot P(\neg creative) \cdot \sum_{project} \cdot P(project|\neg creative, smart)$$
$$\sum_{mac} \sum_{hw} \sum_{success} P(\neg happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(success|project, hw) \cdot P(hw|party, smart)$$
$$= \alpha P(party) \cdot P(smart) \cdot P(\neg creative) \cdot \sum_{project} \cdot P(project|\neg creative, smart)$$
$$[P(\neg happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(success|project, hw) \cdot P(hw|party, smart) +$$
$$P(\neg happy|\neg mac, success, party) \cdot P(\neg mac|\neg creative, smart) \cdot$$
$$P(success|project, hw) \cdot P(hw|party, smart) +$$
$$P(\neg happy|mac, success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(success|project, \neg hw) \cdot P(\neg hw|party, smart) +$$
$$P(\neg happy|mac, \neg success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(\neg success|project, hw) \cdot P(hw|party, smart) +$$
$$P(\neg happy|\neg mac, \neg success, party) \cdot P(\neg mac|\neg creative, smart) \cdot$$
$$P(\neg success|project, hw) \cdot P(hw|party, smart) +$$
$$P(\neg happy|\neg mac, success, party) \cdot P(\neg mac|\neg creative, smart) \cdot$$
$$P(success|project, \neg hw) \cdot P(\neg hw|party, smart) +$$
$$P(\neg happy|mac, \neg success, party) \cdot P(mac|\neg creative, smart) \cdot$$
$$P(\neg success|project, \neg hw) \cdot P(\neg hw|party, smart) +$$
$$P(\neg happy|\neg mac, \neg success, party) \cdot P(\neg mac|\neg creative, smart) \cdot$$
$$P(\neg success|project, \neg hw) \cdot P(\neg hw|party, smart)]$$
$$= 0.308$$

4

$$P(happy|smart, creative) = 0.58156$$

5

$$P(happy|\neg party, hw, project) = 0.32045$$

6

$$P(happy|mac) = 0.56272$$

7

$$P(party|smart) = 0.6022$$

8

$$P(party|smart, happy) = 0.79265$$