Task 1:

P1 P2

Constants:

Red marbles (O): RM1, RM2, RM3, P1 ← Going to refer to these as bags

Blue marbles (●): BM1, BM2, BM3, P2

Predicates:

DiffColor(X, Y) is true if marble x is a different color to marble y.

SameColor(X, Y) is true if marble x is the same color as marble y.

IN(x, y, z) is true if x and y is in z

isP1(x) is true if x is P1

isP2(x) is true if x is P2

isRed(x) is true if marble x is Red

isBlue(x) is true if marble x is Blue

Has(x, y) is true if x has y

Actions:

Action(MoveFromP1(marble1, marble2, bag1, bag2)

PRECOND: DiffColor(marble1, marble2) AND isP1(bag1)

Effect: NOT(IN(marble1, marble2, bag1)) AND IN(marble1, marble2, bag2))

Action(MoveFromP2(marble1, marble2, bag1, bag2)

Precond: SameColor(marble1, marble2) AND isP2(bag2)

Effect: NOT(IN(marble1, marble2, bag2)) AND IN(marble1, marble2, bag1))

State:

isRed(RM1), isRed(RM2), isRed(RM3)

Has(P1, RM1), Has(P1, RM2), Has(P1, RM3)

isBlue(BM1), isBlue(BM2), isBlue(BM3)

Has(P2, BM1), Has(P2, BM2), Has(P2, BM3)

Complete Plan:

MoveFromP2(BM1, BM2, P2)

MoveFromP1(BM1, RM1, P1)

MoveFromP2(BM1, BM3, P2)

MoveFromP1(BM1, RM2, P1)

MoveFromP1(BM3, RM3, P1)

MoveFromP2(BM1, BM3, P2)

Task 2:

4 predicates with 3 arguments
5 constants

1 predicate with 3 args and 5 constants: $2^{5^3} = 2^{125}$
with 4 predicates multiply the exponent by 4.

$2^{125 \times 4} = 2^{500}$

Justification:

with any predicate we need to account all possible combinations of constants. With 3 arguments and 5 constants that means 5^3 combinations. Predicates are only true or false so the base is 2. Lastly there are 4 predicates with three arguments thus we must multiply $5^3 \times 4$ to account for each predicate's possible states. Thus, $2^{5^3 \times 4} = 2^{125 \times 4} = 2^{500}$.

Task 3:

a: $P(\text{Not Green} \mid \text{Truck}) = \dfrac{P(\text{Green} \wedge \text{Truck})}{P(\text{Truck})}$

$$\frac{0.0504 + 0.1032}{0.0504 + 0.1032 + 0.0864} = \frac{0.1536}{0.24} = 0.64$$

b:

	Red	Green	Blue	
Car	.063	0.108	0.129	0.30
Van	.0441	.0756	.0903	0.21
Truck	.0504	.0864	.1032	0.24
SUV	.0525	.09	.1025	0.25
	0.21	0.36	0.43	1

Car · Red: $.3 \times .21 = .063$
Car · Green: $.3 \times .36 = .108$
C · B: $.3 \times .43 = .129$
V · R: $.21 \times .21 = .0441$
V · G: $.21 \times .36 = .0756$
V · B: $.21 \times .43 = .0903$
T · R: $.24 \times .21 = .0504$
T · G: $.24 \times .36 = .0864$
T · B: $.24 \times .43 = .1032$
S · R: $.25 \times .21 = .0525$
S · G: $.25 \times .36 = .09$
S · B: $.25 \times .43 = .1025$

They are all equal, thus color and vehicle are independent.

Task 4:

a: 12 variables: $A, B_1, \ldots, B_{10}, C$

A has 8 possible values

C has 6 possible values, totally independent.

Each $B_1, \ldots, B_{10}$ have 5 possible values.

Each B_i is conditionally independent of all other 9 B_j (with $j != i$) given A.

$$P(B_i | B_j, A) = P(B_i | A)$$

$$P(B_1 | A) P(B_2 | A) \ldots P(B_{10} | A)$$

ind. nums. $2 + 2 + 2 \ldots + 2 = 20$

However, each B_i has 5 values, A has 8 values

$(5 \times 8) = ~~40~~ 40$ possible values

so, $40 + 40 + \ldots + 40 = 400$ possible values

(C)

$400 \times 6 = \underline{2400}$ possible values needed to be stored

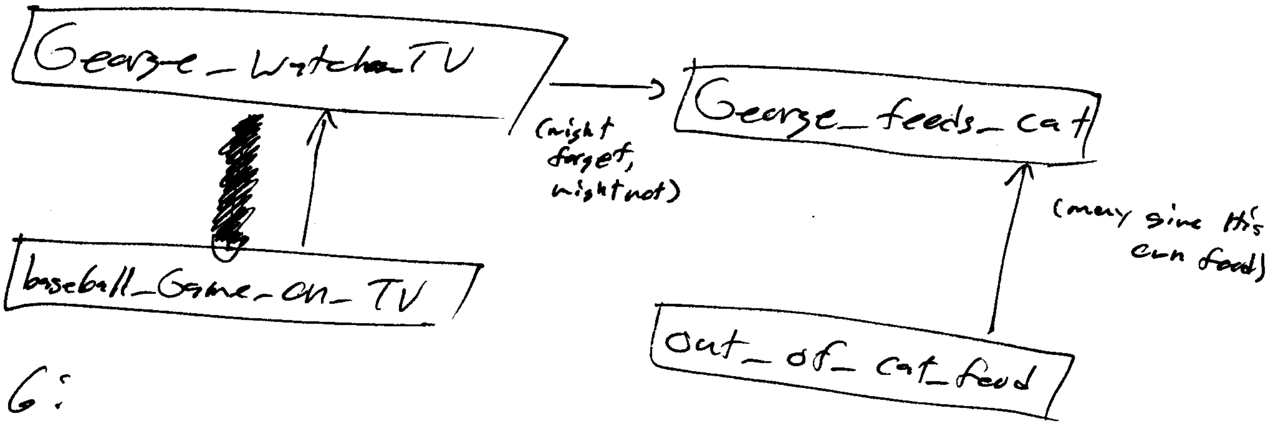
b: $O(40^n)$

Not entirely sure how to answer this question

2400 numbers, one will always be equal to 1 (don't need to store)

2399 numbers is the most space efficient I think

Task 5:



Task 6:

did not do.

Task 7: P(Baseball Game on TV | not(George Feed cat))

$$\frac{P(B \land Not(F))}{P(Not(F))} =$$

did not do

Task 8:

a: parents of "N": "I"
children of "N": "R", "S"
parents of children of "N": "M", "O"

b: $P(I, D) = P(I|D)P(D)$

$P(D) = 0.5$

since D is true and not ¬D, then:

$P(I|D) = 0.5$

$0.5 \cdot 0.5 = 0.25$

d(C?): $P(M, not(C) | H) = \frac{P(M, not(C), H)}{P(H)}$

$P(\neg C) = 0.4$

$= \frac{P(not(C)) * P(M, H | not(C))}{P(H, C) + P(H, \neg C)}$

$= \frac{P(not(C)) * P(H | not(C)) \times P(M|H)}{P(C)P(H|C) + P(\neg C)P(H|\neg C)}$

$= \frac{0.4 \times 0.1 \times 0.1}{0.6 \times 0.6 + 0.4 \times 0.1} = \frac{0.004}{0.4}$

$= 0.01$