

backtracking algorithms assignment

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“Our cargo company has been contracted again to carry goods under the same payment conditions (10€/item) therefore the less trucks they use the better for benefits. In this scenario, an oracle has told the CEO “You can take for granted that this service can be performed by means of just 3 lorries”. You are asked to provide a backtracking algorithm to choose goods to be carried in each truck in order to either find a solution or prove the oracle is wrong.”

# rough description

This algorithm will check all possible options until the solution is found, like building a searching tree of location of the packets. It’ll check for each packet all the combinations allowed discarding those that doesn’t fit in the truck, until the last one. By then, the algorithm will tell us whether we can carry all the goods in the 3 lorries or not.

# formal description

* **Solution type of data:** 1 dimensional array of size n(nº of packets): SOL[i]=j means packet in position i of the array will be carried in lorry number=j
* **Exhaustivity:** Not yet chosen: 0🡪1🡪2🡪3🡪4: backtracking firing condition
* **Dead Node condition:**

if( LorryCap[SOL(i-1)] - packet[i]<0 ){SOL(i)++;}

if (SOL(i)==4{ SOL(i)=0; i=i-1;}

* **Live Node condition:** ┐DEAD NODE { LorryCap[SOL(i-1)] -= packet[i];}
* **Solution Node condition:** if(i==n)&&(LIVE NODE)

# pseudo-code

main()

int i,lorry=4000;

int numgoods;

print "Enter the number of goods: ";

input numgoods;

int goods[numgoods];

int solution[numgoods];

int LorryFreeSpace[3]={lorry,lorry,lorry};

for i=0 to numgoods

print "Introduce the packet"+i+1";

input goods[i]);

solution[i]=0;

fin\_for

switch(backtracking(numgoods,lorry, solution,LorryFreeSpace,goods))

case -1:

print "Oracle was wrong, there is no possible combinations to transport all goods\n";

break;

fin\_case-1

case 1:

print " Oracle was wrong, the weight of all the goods is greater than the lorries total capacity\n";

break;

fin\_case1

case 2:

print " Oracle was wrong, there is at least 1 packet that weights more than 4000\n";

break;

fin\_case2

case 3:

print "Oracle was right\n";

print "Packet ordering list: ";

for i=0 to numgoods

print solution[i];

end\_for

print "\n";

break;

end\_case3

end\_switch

end\_main

int backtracking(int numgoods,int lorry,int solution[], int LorryFreeSpace[], int goods[])

int i,sum=0;

for i=0 to numgood

if lorry<goods[i]

then

return 2;

break;

end\_if

sum+=goods[i];

end\_for

if sum>(LorryFreeSpace[0]+LorryFreeSpace[1]+LorryFreeSpace[2])

then

return 1;

end\_if

i=0;

while i<numgoods && i>-1 do

solution[i]++;

if solution[i]==4

then

solution[i]=0;

if i!=0

then

LorryFreeSpace[ solution[i-1]-1 ]+=goods[i-1];

end\_if

i--;

end\_if

else

if LorryFreeSpace[ solution[i]-1 ]-goods[i] >=0

LorryFreeSpace[ solution[i]-1 ]-=goods[i];

i++;

end\_if

end\_while

if i==-1

then

return -1;

end\_if

return 3;

end\_backtracking

# computational cost

* n stands for the number of goods of the input

for i=0 to numgoods 🡪O

while i<numgoods && i>-1 🡪O

* The best case would be having all goods already ordered in the way that the algorithm doesn’t have to try more than the first option: Ω(n)
* The worst case would be the solution array (n) to the power of the exhaustivity(3), an therefore, the computational cost for the big O is O.
* We can’t determine the θ order of the algorithm.