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CPSC 335-03
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Project 2

Out for the given tests:

C:\Users\Tony\Desktop\project>java KnapsackPackages
Number of packages(<30): 20
Total weight: 1000

--Packages--

Name : debianutils	Votes : 128329	Size : 90
Name : libgcc1	Votes : 128327	Size : 46
Name : debconf	Votes : 121503	Size : 168
Name : gzip	Votes : 121346	Size : 142
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : libselinux1	Votes : 120918	Size : 109

--Run Stats--

Total Size : 935 Total Votes : 1225823
Elapsed time: 0.26 seconds

C:\Users\Tony\Desktop\project>java KnapsackPackages
Number of packages(<30): 23
Total weight: 720

--Packages--

Name : debianutils	Votes : 128329	Size : 90
Name : libgcc1	Votes : 128327	Size : 46
Name : gzip	Votes : 121346	Size : 142
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : base-passwd	Votes : 120856	Size : 49

--Run Stats--

Total Size : 707 Total Votes : 1104258
Elapsed time: 2.26 seconds

C:\Users\Tony\Desktop\project>java KnapsackPackages
Number of packages(<30): 23
Total weight: 1440

--Packages--

Name : debianutils	Votes : 128329	Size : 90
Name : libgcc1	Votes : 128327	Size : 46
Name : debconf	Votes : 121503	Size : 168

Name : gzip	Votes : 121346	Size : 142
Name : sed	Votes : 121220	Size : 261
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : libselinux1	Votes : 120918	Size : 109
Name : cron	Votes : 120872	Size : 120
Name : base-passwd	Votes : 120856	Size : 49

--Run Stats--

Total Size : 1365 Total Votes : 1588771

Elapsed time: 2.31 seconds

C:\Users\Tony\Desktop\project>java KnapsackPackages

Number of packages(<30): 23

Total weight: 25600

--Packages--

Name : debianutils	Votes : 128329	Size : 90
Name : libgcc1	Votes : 128327	Size : 46
Name : dpkg	Votes : 128294	Size : 2672
Name : perl-base	Votes : 127369	Size : 1969
Name : debconf	Votes : 121503	Size : 168
Name : grep	Votes : 121426	Size : 595
Name : gzip	Votes : 121346	Size : 142
Name : login	Votes : 121332	Size : 980
Name : coreutils	Votes : 121240	Size : 6505
Name : bash	Votes : 121229	Size : 1673
Name : sed	Votes : 121220	Size : 261
Name : findutils	Votes : 121173	Size : 805
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : util-linux	Votes : 121022	Size : 846
Name : mount	Votes : 120961	Size : 272
Name : libselinux1	Votes : 120918	Size : 109
Name : cron	Votes : 120872	Size : 120
Name : base-passwd	Votes : 120856	Size : 49
Name : apt	Votes : 120826	Size : 1356

--Run Stats--

Total Size : 19038 Total Votes : 2813643

Elapsed time: 2.68 seconds

C:\Users\Tony\Desktop\project>java KnapsackPackages

Number of packages(<30): 23

Total weight: 65356

--Packages--

Name : debianutils	Votes : 128329	Size : 90
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Name : libgcc1	Votes : 128327	Size : 46
Name : dpkg	Votes : 128294	Size : 2672
Name : perl-base	Votes : 127369	Size : 1969
Name : debconf	Votes : 121503	Size : 168
Name : grep	Votes : 121426	Size : 595
Name : gzip	Votes : 121346	Size : 142
Name : login	Votes : 121332	Size : 980
Name : coreutils	Votes : 121240	Size : 6505
Name : bash	Votes : 121229	Size : 1673
Name : sed	Votes : 121220	Size : 261
Name : findutils	Votes : 121173	Size : 805
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : util-linux	Votes : 121022	Size : 846
Name : mount	Votes : 120961	Size : 272
Name : libselinux1	Votes : 120918	Size : 109
Name : cron	Votes : 120872	Size : 120
Name : base-passwd	Votes : 120856	Size : 49
Name : apt	Votes : 120826	Size : 1356

--Run Stats--

Total Size : 19038 Total Votes : 2813643

Elapsed time: 2.11 seconds

3. (a) The highest value n possible for this algorithm (30) ran in 5 minutes 43 seconds for W = 2000. The output is below:

C:\Users\Tony\Desktop\project>java KnapsackPackages

Number of packages(<30): 30

Total weight: 2000

--Packages--

Name : debianutils	Votes : 128329	Size : 90
Name : libgcc1	Votes : 128327	Size : 46
Name : debconf	Votes : 121503	Size : 168
Name : gzip	Votes : 121346	Size : 142
Name : sed	Votes : 121220	Size : 261
Name : lsb-base	Votes : 121121	Size : 26
Name : sysv-rc	Votes : 121092	Size : 80
Name : sysvinit-utils	Votes : 121078	Size : 116
Name : base-files	Votes : 121072	Size : 65
Name : initscripts	Votes : 121037	Size : 93
Name : mount	Votes : 120961	Size : 272
Name : libselinux1	Votes : 120918	Size : 109
Name : cron	Votes : 120872	Size : 120
Name : base-passwd	Votes : 120856	Size : 49
Name : logrotate	Votes : 120745	Size : 64
Name : popularity-contest	Votes : 120729	Size : 67
Name : libacl1	Votes : 120676	Size : 36
Name : libpopt0	Votes : 120460	Size : 68

Name : zlib1g Votes : 120263 Size : 116

--Run Stats--

Total Size : 1988 Total Votes : 2312605

Elapsed time: 343.62 seconds

(b) The algorithm runs in exponential time, so it becomes very slow as the input size increases. This means that it is only practical for very small input sizes.

4. The source code for this project is on the following pages.

```
public class Package {
    private String name;
    private int size;
    private int votes;

    public Package() {
        name = "";
        size = 0;
        votes = 0;
    }

    public Package(String name, int size, int votes) {
        this.name = name;
        this.size = size;
        this.votes = votes;
    }

    public void setName(String name) {
        this.name = name;
    }

    public void setSize(int size) {
        this.size = size;
    }

    public void setVotes(int votes) {
        this.votes = votes;
    }

    public String getName() {
        return name;
    }

    public int getSize() {
        return size;
    }

    public int getVotes() {
        return votes;
    }
}
```

```
import java.io.*;
import java.util.Scanner;
import java.util.List;
import java.util.ArrayList;

public class KnapsackPackages {
    private static int sumSizes(List<Package> pkgs) {
        //Calculate the sum of sizes in the package list
        int sum = 0;
        for (Package pkg : pkgs)
            sum += pkg.getSize();
        return sum;
    }

    private static int sumVotes(List<Package> pkgs) {
        //Calculate the sum of votes in the package list
        int sum = 0;
        for (Package pkg : pkgs)
            sum += pkg.getVotes();
        return sum;
    }

    public static void main(String[] args) {
        Scanner input = new Scanner(System.in);
        //Get parameters for running algorithm
        System.out.print("Number of packages(<30): ");
        int size = input.nextInt();
        System.out.print("Total weight: ");
        int weight = input.nextInt();
        System.out.println();
        //Setup file reader
        BufferedReader reader = null;
        String strRead = "";
        //Create array of packages
        Package[] pkgs = new Package[size];
        //Create file reader
        try {
            reader = new BufferedReader(new FileReader("packages.txt"));
        } catch (FileNotFoundException e) {
            System.out.println("Error: " + e);
        }
        //Read the file and populate the array
        try {
            strRead = reader.readLine();
            int count = 0;
            while ((strRead = reader.readLine()) != null && count < size) {
                //Split line read from file at space delimiters into a token array
                String splitArray[] = strRead.split(" ");
                //Store data read from file into variables to use to construct
                //a Package object.
                String pkgName = splitArray[0];
                int pkgVotes = Integer.parseInt(splitArray[1]);
                int pkgSize = Integer.parseInt(splitArray[2]);
                pkgs[count] = new Package(pkgName, pkgSize, pkgVotes);
            }
        }
    }
}
```

```

        //Increment count to stop when the size n is reached
        count++;
    }
} catch (IOException e) {
    System.out.println("Error: " + e);
}
//--Knapsack algorithm
int i,j;
List<Package> bestPkgs = null;
//Get start time for timing the algorithm
long start = System.currentTimeMillis();
for (i=0; i<(1<<size); i++) {
    //Create new empty list
    List<Package> s = new ArrayList<Package>();
    for (j=0; j < size; j++) {
        if (((i >> j) & 1) == 1)
            s.add(pkgs[j]);
    }
    if ((sumSizes(s) <= weight) && ((bestPkgs == null)
        || (sumVotes(s) > sumVotes(bestPkgs)))) {
        bestPkgs = s;
    }
}
//Get current time to calculate algorithm's duration
long end = System.currentTimeMillis();
//Print out packages in bestPkgs and the test info
System.out.println("--Packages--");
for (Package pkg : bestPkgs) {
    System.out.format("%-5s: %-18s\t%-6s: %6d \t %-5s: %4d\n",
        "Name",pkg.getName(),
        "Votes",pkg.getVotes(),
        "Size",pkg.getSize());
}
System.out.println("\n" + "--Run Stats--");
System.out.format("%-11s: %4d  %-12s: %6d\n",
    "Total Size", sumSizes(bestPkgs),
    "Total Votes", sumVotes(bestPkgs));
System.out.format("Elapsed time: %.2f seconds",(end-start)/1000.0);
}
}

```