Star Traversal

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CSCI 3412 - Algorithms

Part 1 - Problem Description

For this assignment, we are tasked to plan a trip to visit all the known stars, per the HYG Database, within some specified radius of our solar system. [We're assuming we have a technology that lets us jump instantaneously between stars.] To accomplish this task we first must read the data from the "hygxzy.csv" file, then we need to create a greedy algorithm that will traverse the stars. This problem doesn't care about an optimal shortest path between the stars, but we also don't want to just randomly jump between stars either. Instead, we are going to start at Sol (our sun), then we are going to jump to the nearest star (that is within our specified radius of Sol) and continue to the next nearest star that hasn't been visited until we have visited all the stars that are within our specified radius of Sol. We are going to keep track of the stars traveled (if they have a name) and keep track of the distance traveled as well in parsecs.

Part 2 - Algorithm Design

Pseudo-code for greedy algorithm:

```
function greedy_traversal(stars):
    visited_stars = set()
    current_star = stars[0]
    total_distance = 0.0

    while length(visited_stars) < length(stars):
        min_distance = infinity
        next_star = null

        for star in stars:
            if star not in visited_stars:
                distance = distance_between(current_star, star)
                if distance < min_distance:
                    min_distance = distance
                    next_star = star

        if next_star is not null:
            add next_star to visited_stars
            total_distance += min_distance
            current_star = next_star
        else:
            break
```

This greedy algorithm works by iteratively selecting nearest unvisited star to the current star and moving it. It begins with an arbitrary start star and keeps track of visited stars to ensure each star is visited only once. At each step, the algorithm calculates the distances from the current star to all unvisited stars, selecting the one with the shortest distance as the next star to visit. This process continues until all stars have been visited or until no unvisited stars are reachable from the current position. The algorithm prioritizes immediate gains, aiming to minimize the distance traveled in each step without considering the overall path optimization. As a result, it may not always yield the most optimal traversal path but tends to be efficient in terms of computational complexity.

Part 3 - Implementation and Results

In [2]:

```python
import csv
import math

# Star class represents celestial bodies, Using professor Williams code.
class Star:
    def __init__(self, StarID, HIP, HD, HR, Gliese, BayerFlamsteed, ProperName, RA, Dec, Distance, PMRA, PMDec, RV, Mag, AbsMag, Spectrum, ColorInde

        self.StarID = int(StarID)
        self.HIP = int(HIP) if HIP != '' else None
        self.HD = int(HD) if HD != '' else None
        self.HR = int(HR) if HR != '' else None
        self.Gliese = Gliese if Gliese != '' else None
        self.BayerFlamsteed = BayerFlamsteed
        self.ProperName = ProperName
        self.RA = float(RA)
        self.Dec = float(Dec)
        self.Distance = float(Distance)
        self.PMRA = float(PMRA)
        self.PMDec = float(PMDec)
        self.RV = float(RV) if RV != '' else None
        self.Mag = float(Mag)
        self.AbsMag = float(AbsMag)
        self.Spectrum = Spectrum if Spectrum != '' else None
        self.ColorIndex = float(ColorIndex) if ColorIndex != '' else None
        self.X = float(X)
        self.Y = float(Y)
        self.Z = float(Z)
        self.VX = float(VX)
        self.VY = float(VY)
        self.VZ = float(VZ)

# Function to read stars from a CSV file within a given radius, this is also professor Williams code
def read_stars(filename, radius):
    print("Reading HYG formatted CSV file named", filename)
    stars = []
    with open(filename, 'r') as file:
        # Read (and ignore) the header line
        file.readline()
        for line in file:
            fields = line.strip().split(',')
            if len(fields) == 23:
                # Create a Star object from CSV fields
                star = Star(*fields)
                if distance_from_sol(star) <= radius:  # Check if the star is within the specified radius
                    stars.append(star)
    print("Found", len(stars), "stars within a radius of", radius, "parsecs from Sol.")
    return stars

# Function to calculate distance from Sol (0, 0, 0)
def distance_from_sol(star):
    return (star.X**2 + star.Y**2 + star.Z**2) ** 0.5

# Function to calculate distance between two stars
def distance_between(star1, star2):
    return ((star2.X - star1.X) ** 2 + (star2.Y - star1.Y) ** 2 + (star2.Z - star1.Z) ** 2) ** 0.5

# Greedy traversal algorithm to find a path visiting each star exactly once
def greedy_traversal(stars):
    print("Computing a star traversal using a greedy method.")

    visited_stars = set()  # Set to keep track of visited stars
    current_star = stars[0]  # Start traversal from the first star
    traversal_star_list = []  # List to store traversal path
    total_distance = 0.0  # Initialize total distance traveled

    # Continue until all stars are visited
    while len(visited_stars) < len(stars):
        min_distance = float('inf')  # Initialize minimum distance to infinity
        next_star = None  # Initialize the next star to visit

        # Find the nearest unvisited star to the current star
        for star in stars:
            if star not in visited_stars:
                distance = distance_between(current_star, star)
                if distance < min_distance:
                    min_distance = distance
                    next_star = star

        if next_star:
            visited_stars.add(next_star)  # Mark the next star as visited
            traversal_star_list.append((current_star, next_star, min_distance))  # Add the star pair to traversal path
            total_distance += min_distance  # Update total distance traveled
            current_star = next_star  # Move to the next star
        else:
            break  # Break the loop if no unvisited stars are found

    # Print traversal path
    cumulative_distance = 0.0  # Initialize cumulative distance
    for start, end, distance in traversal_star_list:
        if start != end:  # Skip printing if the start and end stars are the same (Sol)
            cumulative_distance += distance
            print(f"..{identify_star(start)} -> {identify_star(end)} : distance = {distance:.2f}, total distance = {cumulative_distance:.2f}")

    print(f"Total distance traversed is {total_distance:.2f} parsecs.")

# Function to identify star by proper name, Bayer-Flamsteed designation, or Gliese catalog number
def identify_star(star):
    if star.ProperName:
        return star.ProperName
    elif star.BayerFlamsteed:
        return star.BayerFlamsteed
    elif star.Gliese:
        return "Gliese " + star.Gliese
    else:
        return "Unnamed star " + str(star.StarID)

def main():
    # Read stars from the CSV file within a radius of 10.0 parsecs
    stars = read_stars("hygxyz.csv", 10.0)
    # Compute a star traversal using a greedy method
    greedy_traversal(stars)

if __name__ == "__main__":
    main()
```

```
Reading HYG formatted CSV file named hygxyz.csv
Found 327 stars within a radius of 10.0 parsecs from Sol.
Computing a star traversal using a greedy method.
..Sol -> Proxima Centauri : distance = 1.29, total distance = 1.29
..Proxima Centauri -> Rigel Kentaurus B : distance = 0.07, total distance = 1.37
..Rigel Kentaurus B -> Rigel Kentaurus A : distance = 0.00, total distance = 1.37
..Rigel Kentaurus A -> Barnard's Star : distance = 1.98, total distance = 3.35
..Barnard's Star -> Gliese Gl 729 : distance = 1.70, total distance = 5.05
..Gliese Gl 729 -> Lacaille 8760 : distance = 2.26, total distance = 7.31
..Lacaille 8760 -> Gliese Gl 832 : distance = 1.28, total distance = 8.59
..Gliese Gl 832 -> Eps Ind : distance = 1.47, total distance = 10.06
..Eps Ind -> Lacaille 9352 : distance = 1.44, total distance = 11.50
..Lacaille 9352 -> Gliese Gl 866  A : distance = 1.25, total distance = 12.75
..Gliese Gl 866  A -> Unnamed star 113751 : distance = 1.31, total distance = 14.05
..Unnamed star 113751 -> Gliese Gl 876 : distance = 0.28, total distance = 14.34
..Gliese Gl 876 -> Gliese GJ 1002 : distance = 1.57, total distance = 15.91
..Gliese GJ 1002 -> Gliese GJ 1005 A : distance = 0.92, total distance = 16.83
..Gliese GJ 1005 A -> Gliese Gl  54.1 : distance = 1.83, total distance = 18.66
..Gliese Gl  54.1 -> 52Tau Cet : distance = 0.50, total distance = 19.15
..52Tau Cet -> Gliese Gl  65  A : distance = 1.03, total distance = 20.18
..Gliese Gl  65  A -> Gliese Gl  65  B : distance = 0.00, total distance = 20.18
..Gliese Gl  65  B -> 18Eps Eri : distance = 1.57, total distance = 21.75
..18Eps Eri -> Unnamed star 15650 : distance = 1.22, total distance = 22.97
..Unnamed star 15650 -> 40Omi2Eri : distance = 1.33, total distance = 24.30
..40Omi2Eri -> Gliese Gl 166  B : distance = 0.01, total distance = 24.31
..Gliese Gl 166  B -> Gliese Gl 166  C : distance = 0.00, total distance = 24.31
..Gliese Gl 166  C -> Gliese NN 3323 : distance = 1.56, total distance = 25.87
..Gliese NN 3323 -> Gliese Gl 205 : distance = 0.94, total distance = 26.81
..Gliese Gl 205 -> Gliese NN 3379 : distance = 0.98, total distance = 27.79
..Gliese NN 3379 -> Gliese Gl 213 : distance = 1.12, total distance = 28.91
..Gliese Gl 213 -> Gliese Gl 223.2 : distance = 1.92, total distance = 30.83
..Gliese Gl 223.2 -> Gliese GJ 1087 : distance = 1.94, total distance = 32.78
..Gliese GJ 1087 -> Gliese Gl 203 : distance = 1.39, total distance = 34.16
..Gliese Gl 203 -> 1Pi 3Ori : distance = 1.58, total distance = 35.74
..1Pi 3Ori -> Gliese Gl 183 : distance = 2.06, total distance = 37.80
..Gliese Gl 183 -> Gliese NN 3306 : distance = 1.25, total distance = 39.05
..Gliese NN 3306 -> Gliese NN 3325 : distance = 1.75, total distance = 40.80
..Gliese NN 3325 -> Gliese Gl 190 : distance = 0.24, total distance = 41.05
..Gliese Gl 190 -> Gliese Gl 185  B : distance = 0.96, total distance = 42.01
..Gliese Gl 185  B -> Gliese Gl 185  A : distance = 0.00, total distance = 42.01
..Gliese Gl 185  A -> Gliese Gl 216  B : distance = 1.56, total distance = 43.57
..Gliese Gl 216  B -> 13Gam Lep : distance = 0.01, total distance = 43.57
..13Gam Lep -> Unnamed star 20916 : distance = 2.79, total distance = 46.36
..Unnamed star 20916 -> Gliese GJ 1054 B : distance = 2.69, total distance = 49.05
..Gliese GJ 1054 B -> Gliese NN 3193 B : distance = 1.99, total distance = 51.03
..Gliese NN 3193 B -> 23Del Eri : distance = 2.26, total distance = 53.29
..23Del Eri -> Gliese GJ 1065 : distance = 0.83, total distance = 54.12
..Gliese GJ 1065 -> 96Kap1Cet : distance = 2.03, total distance = 56.15
..96Kap1Cet -> Gliese GJ 1057 : distance = 0.76, total distance = 56.91
..Gliese GJ 1057 -> Gliese Gl 105  B : distance = 1.80, total distance = 58.71
..Gliese Gl 105  B -> 268 G. Cet : distance = 0.00, total distance = 58.72
..268 G. Cet -> Gliese NN 3146 : distance = 1.68, total distance = 60.40
..Gliese NN 3146 -> Gliese NN 3128 : distance = 0.86, total distance = 61.26
..Gliese NN 3128 -> Gliese NN 3076 : distance = 2.08, total distance = 63.34
..Gliese NN 3076 -> 107    Psc : distance = 1.59, total distance = 64.93
..107    Psc -> Gliese Gl 109 : distance = 1.98, total distance = 66.91
..Gliese Gl 109 -> Gliese Gl 102 : distance = 2.24, total distance = 69.15
..Gliese Gl 102 -> Gliese NN 3253 : distance = 3.38, total distance = 72.53
..Gliese NN 3253 -> Gliese NN 3275 : distance = 1.23, total distance = 73.76
..Gliese NN 3275 -> Unnamed star 21879 : distance = 0.84, total distance = 74.60
..Unnamed star 21879 -> Gliese Gl 176 : distance = 0.11, total distance = 74.71
..Gliese Gl 176 -> Gliese NN 3304 : distance = 1.71, total distance = 76.42
..Gliese NN 3304 -> 54Chi1Ori : distance = 3.36, total distance = 79.78
..54Chi1Ori -> Gliese Gl 232 : distance = 1.19, total distance = 80.97
..Gliese Gl 232 -> Gliese GJ 1093 : distance = 1.39, total distance = 82.36
..Gliese GJ 1093 -> Gliese Gl 239 : distance = 2.25, total distance = 84.61
..Gliese Gl 239 -> Gliese Gl 250  A : distance = 3.87, total distance = 88.48
..Gliese Gl 250  A -> Gliese Gl 250  B : distance = 0.00, total distance = 88.49
..Gliese Gl 250  B -> Gliese GJ 1103 A : distance = 2.40, total distance = 90.88
..Gliese GJ 1103 A -> Gliese GJ 1103 B : distance = 0.00, total distance = 90.88
..Gliese GJ 1103 B -> Gliese GJ 2066 : distance = 1.04, total distance = 91.92
..Gliese GJ 2066 -> Gliese NN 3517 : distance = 1.73, total distance = 93.65
..Gliese NN 3517 -> Gliese GJ 1125 : distance = 1.93, total distance = 95.58
..Gliese GJ 1125 -> Gliese Gl 382 : distance = 2.50, total distance = 98.08
..Gliese Gl 382 -> Gliese Gl 393 : distance = 1.00, total distance = 99.08
..Gliese Gl 393 -> Gliese Gl 402 : distance = 1.83, total distance = 100.91
..Gliese Gl 402 -> Gliese Gl 388 : distance = 1.56, total distance = 102.47
..Gliese Gl 388 -> Gliese GJ 1116 B : distance = 1.71, total distance = 104.19
..Gliese GJ 1116 B -> Gliese GJ 1116 A : distance = 0.00, total distance = 104.19
..Gliese GJ 1116 A -> Gliese NN 3522 : distance = 1.22, total distance = 105.40
..Gliese NN 3522 -> Gliese GJ 1111 : distance = 1.60, total distance = 107.01
..Gliese GJ 1111 -> Gliese Gl 280  B : distance = 1.53, total distance = 108.54
..Gliese Gl 280  B -> Procyon : distance = 0.00, total distance = 108.54
..Procyon -> Luyten's Star : distance = 0.36, total distance = 108.89
..Luyten's Star -> Gliese Gl 234  A : distance = 1.18, total distance = 110.08
..Gliese Gl 234  A -> Gliese Gl 234  B : distance = 0.00, total distance = 110.08
..Gliese Gl 234  B -> Gliese Gl 244  B : distance = 1.70, total distance = 111.77
..Gliese Gl 244  B -> Sirius : distance = 0.00, total distance = 111.77
..Sirius -> Kapteyn's Star : distance = 2.29, total distance = 114.07
..Kapteyn's Star -> Gliese GJ 1061 : distance = 1.26, total distance = 115.33
..Gliese GJ 1061 -> 82 G. Eri : distance = 1.79, total distance = 117.12
..82 G. Eri -> Gliese GJ 2034 : distance = 2.54, total distance = 119.66
..Gliese GJ 2034 -> p Eridani : distance = 3.56, total distance = 123.22
..p Eridani -> Gliese Gl  66  A : distance = 0.00, total distance = 123.22
..Gliese Gl  66  A -> Gliese Gl  54 : distance = 1.67, total distance = 124.89
..Gliese Gl  54 -> Zet Tuc : distance = 0.95, total distance = 125.83
..Zet Tuc -> Gliese Gl 877 : distance = 1.89, total distance = 127.72
..Gliese Gl 877 -> Bet Hyi : distance = 1.38, total distance = 129.11
..Bet Hyi -> Gliese NN 4285 : distance = 1.86, total distance = 130.97
..Gliese NN 4285 -> Del Pav : distance = 1.82, total distance = 132.79
..Del Pav -> Gliese Gl 693 : distance = 1.95, total distance = 134.74
..Gliese Gl 693 -> Unnamed star 82474 : distance = 1.17, total distance = 135.91
..Unnamed star 82474 -> Gliese Gl 674 : distance = 1.39, total distance = 137.31
..Gliese Gl 674 -> Gliese Gl 682 : distance = 0.56, total distance = 137.87
..Gliese Gl 682 -> Unnamed star 86694 : distance = 1.66, total distance = 139.52
..Unnamed star 86694 -> Unnamed star 86696 : distance = 0.00, total distance = 139.52
..Unnamed star 86696 -> Gliese Gl 664 : distance = 0.93, total distance = 140.46
..Gliese Gl 664 -> 36    Oph : distance = 0.03, total distance = 140.48
..36    Oph -> 36    Oph : distance = 0.00, total distance = 140.49
..36    Oph -> Gliese Gl 667  B : distance = 1.37, total distance = 141.85
..Gliese Gl 667  B -> Gliese Gl 667  C : distance = 0.00, total distance = 141.85
..Gliese Gl 667  C -> Gliese Gl 667  A : distance = 0.00, total distance = 141.86
..Gliese Gl 667  A -> Gliese Gl 618  B : distance = 2.21, total distance = 144.07
..Gliese Gl 618  B -> Gliese Gl 618  A : distance = 0.00, total distance = 144.07
..Gliese Gl 618  A -> Gliese Gl 633 : distance = 1.82, total distance = 145.89
..Gliese Gl 633 -> Gliese Gl 666  B : distance = 1.31, total distance = 147.20
..Gliese Gl 666  B -> Gliese Gl 666  A : distance = 0.00, total distance = 147.20
..Gliese Gl 666  A -> Gliese Gl 680 : distance = 1.13, total distance = 148.33
..Gliese Gl 680 -> Unnamed star 82473 : distance = 2.52, total distance = 150.86
..Unnamed star 82473 -> Gliese Gl 588 : distance = 4.46, total distance = 155.32
..Gliese Gl 588 -> Gliese NN 3877 : distance = 1.61, total distance = 156.93
..Gliese NN 3877 -> 33 G. Lib : distance = 0.78, total distance = 157.70
..33 G. Lib -> Gliese Gl 555 : distance = 1.12, total distance = 158.82
..Gliese Gl 555 -> Gliese Gl 581 : distance = 1.31, total distance = 160.13
..Gliese Gl 581 -> Gliese Gl 570  B : distance = 2.13, total distance = 162.26
..Gliese Gl 570  B -> Gliese Gl 595 : distance = 1.62, total distance = 163.89
..Gliese Gl 595 -> Gliese Gl 643 : distance = 3.16, total distance = 167.05
..Gliese Gl 643 -> Gliese Gl 644  A : distance = 0.76, total distance = 167.80
..Gliese Gl 644  A -> Gliese Gl 644  B : distance = 0.00, total distance = 167.80
..Gliese Gl 644  B -> Gliese Gl 644  C : distance = 0.01, total distance = 167.81
..Gliese Gl 644  C -> Gliese Gl 628 : distance = 1.61, total distance = 169.42
..Gliese Gl 628 -> Gliese Gl 563.2B : distance = 2.00, total distance = 171.42
..Gliese Gl 563.2B -> Gliese Gl 563.2A : distance = 0.26, total distance = 171.68
..Gliese Gl 563.2A -> Gliese Gl 447 : distance = 3.56, total distance = 175.25
..Gliese Gl 447 -> Gliese Gl 406 : distance = 1.18, total distance = 176.42
..Gliese Gl 406 -> Lalande 21185 : distance = 1.24, total distance = 177.67
..Lalande 21185 -> Gliese Gl 412  B : distance = 2.33, total distance = 180.00
..Gliese Gl 412  B -> Gliese Gl 412  A : distance = 0.01, total distance = 180.00
..Gliese Gl 412  A -> Groombridge 1618 : distance = 0.93, total distance = 180.93
..Groombridge 1618 -> Gliese Gl 338  A : distance = 1.60, total distance = 182.53
..Gliese Gl 338  A -> Gliese Gl 338  B : distance = 0.08, total distance = 182.62
..Gliese Gl 338  B -> Gliese Gl 268 : distance = 2.80, total distance = 185.42
..Gliese Gl 268 -> Gliese Gl 251 : distance = 0.88, total distance = 186.30
..Gliese Gl 251 -> Unnamed star 33139 : distance = 0.25, total distance = 186.54
..Unnamed star 33139 -> Gliese NN 3454 : distance = 2.89, total distance = 189.43
..Gliese NN 3454 -> Gliese Gl 285 : distance = 0.49, total distance = 189.93
..Gliese Gl 285 -> Gliese Gl 299 : distance = 1.26, total distance = 191.19
..Gliese Gl 299 -> Gliese GJ 2069 B : distance = 2.54, total distance = 193.73
..Gliese GJ 2069 B -> Gliese GJ 1105 : distance = 3.43, total distance = 197.16
..Gliese GJ 1105 -> Gliese NN 3421 : distance = 2.42, total distance = 199.59
..Gliese NN 3421 -> Gliese NN 3380 : distance = 1.61, total distance = 201.20
..Gliese NN 3380 -> Gliese NN 3378 : distance = 2.23, total distance = 203.42
..Gliese NN 3378 -> Gliese NN 3417 : distance = 1.00, total distance = 204.42
..Gliese NN 3417 -> Gliese NN 3512 : distance = 2.97, total distance = 207.39
..Gliese NN 3512 -> Gliese Gl 424 : distance = 3.25, total distance = 210.64
..Gliese Gl 424 -> Gliese GJ 1151 : distance = 2.83, total distance = 213.48
..Gliese GJ 1151 -> 8Bet CVn : distance = 1.50, total distance = 214.98
..8Bet CVn -> Gliese Gl 450 : distance = 1.53, total distance = 216.51
..Gliese Gl 450 -> Groombridge 1830 : distance = 0.72, total distance = 217.23
..Groombridge 1830 -> Gliese Gl 451  B : distance = 0.01, total distance = 217.24
..Gliese Gl 451  B -> 61    UMa : distance = 0.80, total distance = 218.04
..61    UMa -> Gliese GJ 1138 : distance = 1.80, total distance = 219.83
..Gliese GJ 1138 -> Gliese NN 3667 : distance = 3.27, total distance = 223.10
..Gliese NN 3667 -> Gliese Gl 408 : distance = 2.41, total distance = 225.51
..Gliese Gl 408 -> Gliese GJ 1156 : distance = 2.53, total distance = 228.05
..Gliese GJ 1156 -> Gliese GJ 2097 : distance = 1.70, total distance = 229.75
..Gliese GJ 2097 -> Gliese Gl 526 : distance = 1.49, total distance = 231.24
..Gliese Gl 526 -> Gliese Gl 473  A : distance = 1.93, total distance = 233.16
..Gliese Gl 473  A -> Gliese Gl 473  B : distance = 0.00, total distance = 233.16
..Gliese Gl 473  B -> Gliese NN 3622 : distance = 2.53, total distance = 235.69
..Gliese NN 3622 -> Gliese Gl 300 : distance = 3.67, total distance = 239.36
..Gliese Gl 300 -> Gliese Gl 229 : distance = 2.85, total distance = 242.21
..Gliese Gl 229 -> Gliese Gl 257  A : distance = 3.66, total distance = 245.87
..Gliese Gl 257  A -> Gliese Gl 257  B : distance = 0.00, total distance = 245.87
..Gliese Gl 257  B -> Gliese Gl 293 : distance = 3.36, total distance = 249.23
..Gliese Gl 293 -> Gliese GJ 1128 : distance = 1.35, total distance = 250.58
..Gliese GJ 1128 -> Gliese NN 3618 : distance = 1.95, total distance = 252.53
..Gliese NN 3618 -> Gliese Gl 440 : distance = 0.63, total distance = 253.17
..Gliese Gl 440 -> Unnamed star 54139 : distance = 2.18, total distance = 255.34
..Unnamed star 54139 -> Gliese Gl 438 : distance = 2.10, total distance = 257.44
..Gliese Gl 438 -> Gliese Gl 479 : distance = 1.82, total distance = 259.26
..Gliese Gl 479 -> Gliese Gl 480.1 : distance = 2.36, total distance = 261.63
..Gliese Gl 480.1 -> Gliese NN 3737 : distance = 0.82, total distance = 262.45
..Gliese NN 3737 -> Gliese Gl 442  B : distance = 2.52, total distance = 264.97
..Gliese Gl 442  B -> Gliese Gl 442  A : distance = 0.00, total distance = 264.97
..Gliese Gl 442  A -> Gliese Gl 433 : distance = 1.33, total distance = 266.30
..Gliese Gl 433 -> Gliese Gl 432  A : distance = 0.50, total distance = 266.81
..Gliese Gl 432  A -> Gliese Gl 432  B : distance = 0.00, total distance = 266.81
..Gliese Gl 432  B -> Gliese Gl 465 : distance = 3.03, total distance = 269.83
..Gliese Gl 465 -> Gliese NN 3707 : distance = 0.74, total distance = 270.57
..Gliese NN 3707 -> Gliese GJ 1154 A : distance = 2.42, total distance = 273.00
..Gliese GJ 1154 A -> Gliese Gl 486 : distance = 1.81, total distance = 274.81
..Gliese Gl 486 -> Gliese Gl 493.1 : distance = 0.74, total distance = 275.55
..Gliese Gl 493.1 -> Gliese Gl 514 : distance = 1.30, total distance = 276.84
..Gliese Gl 514 -> Gliese Gl 518 : distance = 1.10, total distance = 277.95
..Gliese Gl 518 -> 61    Vir : distance = 3.27, total distance = 281.22
..61    Vir -> Gliese NN 3820 : distance = 1.54, total distance = 282.75
..Gliese NN 3820 -> Gliese Gl 566  B : distance = 5.86, total distance = 288.61
..Gliese Gl 566  B -> 37Xi  Boo : distance = 0.00, total distance = 288.61
..37Xi  Boo -> Gliese NN 3839 : distance = 2.80, total distance = 291.41
..Gliese NN 3839 -> Gliese NN 3801 : distance = 1.22, total distance = 292.63
..Gliese NN 3801 -> Gliese NN 3789 : distance = 1.35, total distance = 293.98
..Gliese NN 3789 -> 43Bet Com : distance = 1.40, total distance = 295.38
..43Bet Com -> Gliese Gl 569  A : distance = 4.39, total distance = 299.77
..Gliese Gl 569  A -> Gliese NN 3976 : distance = 4.82, total distance = 304.59
..Gliese NN 3976 -> Gliese Gl 638 : distance = 1.93, total distance = 306.52
..Gliese Gl 638 -> Gliese NN 3959 : distance = 1.37, total distance = 307.89
..Gliese NN 3959 -> Gliese NN 3988 : distance = 2.08, total distance = 309.97
..Gliese NN 3988 -> Gliese Gl 694 : distance = 1.74, total distance = 311.72
..Gliese Gl 694 -> Gliese NN 4063 : distance = 2.08, total distance = 313.80
..Gliese NN 4063 -> Vega : distance = 0.37, total distance = 314.17
..Vega -> Gliese Gl 747  A : distance = 1.29, total distance = 315.45
..Gliese Gl 747  A -> Gliese Gl 747  B : distance = 0.00, total distance = 315.45
..Gliese Gl 747  B -> Gliese GJ 1230 B : distance = 1.53, total distance = 316.99
..Gliese GJ 1230 B -> Gliese GJ 1230 A : distance = 0.00, total distance = 316.99
..Gliese GJ 1230 A -> Gliese Gl 745  A : distance = 1.61, total distance = 318.60
..Gliese Gl 745  A -> Gliese Gl 745  B : distance = 0.24, total distance = 318.84
..Gliese Gl 745  B -> 86Mu  Her : distance = 2.97, total distance = 321.81
..86Mu  Her -> Gliese Gl 695  B : distance = 0.00, total distance = 321.81
..Gliese Gl 695  B -> Gliese Gl 695  C : distance = 0.00, total distance = 321.81
..Gliese Gl 695  C -> Gliese Gl 686 : distance = 1.37, total distance = 323.19
..Gliese Gl 686 -> Gliese Gl 673 : distance = 2.34, total distance = 325.53
..Gliese Gl 673 -> Gliese Gl 701 : distance = 1.50, total distance = 327.03
..Gliese Gl 701 -> Gliese GJ 1224 : distance = 1.75, total distance = 328.78
..Gliese GJ 1224 -> 70    Oph : distance = 3.15, total distance = 331.93
..70    Oph -> Gliese Gl 702  B : distance = 0.00, total distance = 331.93
..Gliese Gl 702  B -> Gliese Gl 752  A : distance = 1.88, total distance = 333.82
..Gliese Gl 752  A -> Gliese Gl 752  B : distance = 0.00, total distance = 333.82
..Gliese Gl 752  B -> Altair : distance = 1.14, total distance = 334.96
..Altair -> Unnamed star 102709 : distance = 2.77, total distance = 337.74
..Unnamed star 102709 -> Gliese Gl 783  B : distance = 2.19, total distance = 339.93
..Gliese Gl 783  B -> Gliese Gl 783  A : distance = 0.00, total distance = 339.93
..Gliese Gl 783  A -> Gliese Gl 784 : distance = 0.98, total distance = 340.91
..Gliese Gl 784 -> Gliese Gl 754 : distance = 1.09, total distance = 342.01
..Gliese Gl 754 -> Unnamed star 93157 : distance = 2.75, total distance = 344.76
..Unnamed star 93157 -> Gliese Gl 785 : distance = 2.79, total distance = 347.55
..Gliese Gl 785 -> Gliese Gl 803 : distance = 1.70, total distance = 349.25
..Gliese Gl 803 -> Gliese NN 4248 : distance = 2.94, total distance = 352.19
..Gliese NN 4248 -> Gliese Gl 879 : distance = 3.03, total distance = 355.21
..Gliese Gl 879 -> Fomalhaut : distance = 0.27, total distance = 355.48
..Fomalhaut -> Unnamed star 113816 : distance = 1.02, total distance = 356.50
..Unnamed star 113816 -> Gliese Gl 884 : distance = 1.88, total distance = 358.38
..Gliese Gl 884 -> Gliese Gl 867  A : distance = 0.93, total distance = 359.31
..Gliese Gl 867  A -> Gliese Gl 867  B : distance = 0.00, total distance = 359.31
..Gliese Gl 867  B -> Gliese NN 4274 : distance = 1.36, total distance = 360.67
..Gliese NN 4274 -> Gliese GJ 1276 : distance = 1.87, total distance = 362.55
..Gliese GJ 1276 -> Gliese GJ 1286 : distance = 1.71, total distance = 364.25
..Gliese GJ 1286 -> Gliese Gl 908 : distance = 1.42, total distance = 365.67
..Gliese Gl 908 -> Gliese Gl 896  A : distance = 1.93, total distance = 367.61
..Gliese Gl 896  A -> Gliese Gl 896  B : distance = 0.00, total distance = 367.61
..Gliese Gl 896  B -> Gliese Gl 880 : distance = 1.21, total distance = 368.82
..Gliese Gl 880 -> Gliese Gl 829 : distance = 2.46, total distance = 371.28
..Gliese Gl 829 -> Gliese NN 4247 : distance = 2.82, total distance = 374.11
..Gliese NN 4247 -> Gliese GJ 1289 : distance = 3.49, total distance = 377.60
..Gliese GJ 1289 -> Gliese Gl 892 : distance = 3.13, total distance = 380.73
..Gliese Gl 892 -> Gliese Gl  34  B : distance = 1.50, total distance = 382.23
..Gliese Gl  34  B -> 24Eta Cas : distance = 0.00, total distance = 382.23
..24Eta Cas -> Gliese Gl  53  B : distance = 1.66, total distance = 383.90
..Gliese Gl  53  B -> 30Mu  Cas : distance = 0.01, total distance = 383.90
..30Mu  Cas -> Gliese Gl  51 : distance = 1.82, total distance = 385.72
..Gliese Gl  51 -> Gliese Gl  75 : distance = 1.29, total distance = 387.01
..Gliese Gl  75 -> Gliese NN 3126 : distance = 0.27, total distance = 387.28
..Gliese NN 3126 -> Gliese Gl  48 : distance = 2.40, total distance = 389.67
..Gliese Gl  48 -> Gliese Gl 226 : distance = 3.03, total distance = 392.71
..Gliese Gl 226 -> 44Chi Dra : distance = 4.02, total distance = 396.73
..44Chi Dra -> Gliese NN 4053 : distance = 1.17, total distance = 397.89
..Gliese NN 4053 -> Gliese GJ 1227 : distance = 1.11, total distance = 399.01
..Gliese GJ 1227 -> Gliese Gl 793 : distance = 2.05, total distance = 401.05
..Gliese Gl 793 -> Gliese Gl 809 : distance = 1.06, total distance = 402.12
..Gliese Gl 809 -> 61Sig Dra : distance = 1.77, total distance = 403.89
..61Sig Dra -> Gliese GJ 1221 : distance = 0.99, total distance = 404.88
..Gliese GJ 1221 -> Gliese Gl 687 : distance = 1.63, total distance = 406.51
..Gliese Gl 687 -> Gliese Gl 725  A : distance = 1.24, total distance = 407.75
..Gliese Gl 725  A -> Gliese Gl 725  B : distance = 0.05, total distance = 407.81
..Gliese Gl 725  B -> Gliese GJ 1245 A : distance = 1.78, total distance = 409.59
..Gliese GJ 1245 A -> Gliese GJ 1245 B : distance = 0.00, total distance = 409.59
..Gliese GJ 1245 B -> 61    Cyg : distance = 1.60, total distance = 411.19
..61    Cyg -> 61    Cyg : distance = 0.02, total distance = 411.21
..61    Cyg -> Kruger 60 : distance = 1.58, total distance = 412.79
..Kruger 60 -> Gliese Gl 860  B : distance = 0.00, total distance = 412.80
..Gliese Gl 860  B -> Gliese Gl 905 : distance = 1.38, total distance = 414.18
..Gliese Gl 905 -> Gliese Gl  15  B : distance = 0.55, total distance = 414.73
..Gliese Gl  15  B -> Gliese Gl  15  A : distance = 0.00, total distance = 414.73
..Gliese Gl  15  A -> Gliese Gl 873 : distance = 1.91, total distance = 416.64
..Gliese Gl 873 -> Van Maanen's Star : distance = 3.83, total distance = 420.48
..Van Maanen's Star -> Gliese Gl  83.1 : distance = 1.47, total distance = 421.95
..Gliese Gl  83.1 -> 96 G. Psc : distance = 3.57, total distance = 425.52
..96 G. Psc -> Gliese NN 3119 : distance = 3.86, total distance = 429.37
..Gliese NN 3119 -> Gliese Gl  84 : distance = 2.11, total distance = 431.48
..Gliese Gl  84 -> Gliese NN 3135 : distance = 2.07, total distance = 433.55
..Gliese NN 3135 -> Gliese GJ 1028 : distance = 3.15, total distance = 436.70
..Gliese GJ 1028 -> Gliese GJ 2012 : distance = 1.20, total distance = 437.90
..Gliese GJ 2012 -> Gliese GJ 2005 : distance = 2.56, total distance = 440.47
..Gliese GJ 2005 -> Gliese Gl 915 : distance = 2.23, total distance = 442.70
..Gliese Gl 915 -> Gliese GJ 1001 : distance = 1.84, total distance = 444.54
..Gliese GJ 1001 -> Gliese NN 3049 : distance = 1.29, total distance = 445.82
..Gliese NN 3049 -> Gliese NN 4360 : distance = 4.66, total distance = 450.49
..Gliese NN 4360 -> Gliese Gl 849 : distance = 4.04, total distance = 454.53
..Gliese Gl 849 -> Gliese Gl 831  A : distance = 1.75, total distance = 456.28
..Gliese Gl 831  A -> Gliese Gl 831  B : distance = 0.00, total distance = 456.28
..Gliese Gl 831  B -> Gliese Gl 791.2 : distance = 3.67, total distance = 459.95
..Gliese Gl 791.2 -> Gliese GJ 1256 : distance = 1.50, total distance = 461.45
..Gliese GJ 1256 -> Gliese GJ 1253 : distance = 7.06, total distance = 468.51
..Gliese GJ 1253 -> Gliese Gl 661  B : distance = 5.12, total distance = 473.63
..Gliese Gl 661  B -> Gliese Gl 661  A : distance = 0.00, total distance = 473.63
..Gliese Gl 661  A -> Gliese NN 3991 : distance = 0.96, total distance = 474.59
..Gliese NN 3991 -> Gliese Gl 623 : distance = 1.45, total distance = 476.04
..Gliese Gl 623 -> Gliese Gl 625 : distance = 1.64, total distance = 477.69
..Gliese Gl 625 -> Unnamed star 85346 : distance = 3.54, total distance = 481.23
..Unnamed star 85346 -> Gliese Gl 445 : distance = 5.56, total distance = 486.79
..Gliese Gl 445 -> Gliese Gl 169.1B : distance = 3.39, total distance = 490.18
..Gliese Gl 169.1B -> Gliese Gl 169.1A : distance = 0.00, total distance = 490.18
..Gliese Gl 169.1A -> Gliese Wo 9492 : distance = 7.92, total distance = 498.10
..Gliese Wo 9492 -> Gliese NN 3855 : distance = 1.12, total distance = 499.22
..Gliese NN 3855 -> Gliese Gl 678.1A : distance = 10.42, total distance = 509.64
..Gliese Gl 678.1A -> Gliese GJ 1207 : distance = 2.24, total distance = 511.88
..Gliese GJ 1207 -> 12    Oph : distance = 0.96, total distance = 512.84
..12    Oph -> Unnamed star 84326 : distance = 2.00, total distance = 514.83
..Unnamed star 84326 -> Gliese Gl   1 : distance = 11.14, total distance = 525.98
..Gliese Gl   1 -> Gam Pav : distance = 6.26, total distance = 532.24
..Gam Pav -> Unnamed star 31220 : distance = 5.55, total distance = 537.78
..Unnamed star 31220 -> Unnamed star 31215 : distance = 0.39, total distance = 538.18
..Unnamed star 31215 -> Gliese GJ 1123 : distance = 1.52, total distance = 539.70
..Gliese GJ 1123 -> Gliese Gl 367 : distance = 5.23, total distance = 544.93
..Gliese Gl 367 -> Gliese Gl 358 : distance = 0.87, total distance = 545.79
..Gliese Gl 358 -> Gliese Gl 318 : distance = 2.34, total distance = 548.13
..Gliese Gl 318 -> Gliese Gl 357 : distance = 2.57, total distance = 550.70
..Gliese Gl 357 -> Gliese Gl 283  A : distance = 4.26, total distance = 554.97
..Gliese Gl 283  A -> Gliese Gl 283  B : distance = 0.00, total distance = 554.97
Total distance traversed is 554.97 parsecs.
```

Part 4 - Conclusion

The results I got from my program matches the same output we are given, so that means that I properly implemented the greedy algorithm, within this algorithm the distance between each star in a certain radius was calculated and this program also visited evey star within that radius and tries to properly name them. Overall, this programming assignment taught me how to implement a greedy algorithm which is useful when dealing with large amounts of data.