

Software Engineering Project 1 (Comp 10050)

Assignment 3 – GPS Analysis

Aim of the assignment: to extend a C program for analysing GPS data in gpx format to extract summary statistics from GPS track information.

A. Detailed Specification

Many applications that work with GPS data can export data in the XML-based gpx format (http://en.wikipedia.org/wiki/GPX_eXchange_Format) - see sample in Figure 1. For instance the fitness app Runkeeper (runkeeper.com) exports details of training data in this format.

Figure 1. Sample gpx data showing header information and the beginning of a <trkseg>.

```
<?xml version="1.0" encoding="UTF-8"?>
<gpx
  version="1.1"
  creator="RunKeeper - http://www.runkeeper.com"
  xmlns:xsi="http://www.w3.org/2003/XMLSchema-instance"
  xmlns="http://www.topografix.com/GPX/1/1"
  xsi:schemaLocation="http://www.topografix.com/GPX/1/1 http://www.topografix.com/GPX/1/1/gpx.xsd"
  xmlns:gpptpx="http://www.garmin.com/xmlschemas/TrackPointExtension/v1">
  <trk>
    <name><![CDATA[Running 9/12/13 3:50 pm]]></name>
    <time>2013-09-12T15:50:29Z</time>
    <trkseg>
      <trkpt lat="53.388055000" lon="-6.228524000"><ele>24.4</ele><time>2013-09-12T15:50:29Z</time></trkpt>
      <trkpt lat="53.388055000" lon="-6.228537000"><ele>24.3</ele><time>2013-09-12T15:50:30Z</time></trkpt>
      <trkpt lat="53.388011000" lon="-6.228660000"><ele>24.3</ele><time>2013-09-12T15:50:38Z</time></trkpt>
      <trkpt lat="53.387903000" lon="-6.228801000"><ele>24.3</ele><time>2013-09-12T15:50:44Z</time></trkpt>
      <trkpt lat="53.387960000" lon="-6.228938000"><ele>24.2</ele><time>2013-09-12T15:50:53Z</time></trkpt>
      <trkpt lat="53.387875000" lon="-6.229002000"><ele>24.2</ele><time>2013-09-12T15:51:00Z</time></trkpt>
```

The task for this assignment is to take a basic program that is provided and extend it to produce summary statistics in the following format.

Split No.	Pace m:s	Speed km/h	Elevation m
1	5:41	10.53	-0
2	7:01	8.54	46
3	5:56	10.10	11
4	6:03	9.92	12
5	6:48	8.81	45
6	7:48	7.68	3
7	3:29	17.20	-38

The splits are each km, the pace is in minutes and seconds, the speed is in km/h and the elevation change is in metres.

The C program `GPSTransformBasic.c` is provided as a starting point. It can read a gpx data file in the format shown in Figure 1, load the track data into a linked list and calculate the total time and the distance covered.

While the gpx format allows for multiple track segments (delimited by <trkseg> and </trkseg> tags), your program need only process a single track, i.e. you can assume that it will be tested on gpx files with only a single track.

Required Extensions

In order to produce statistics in the format shown in the table above, the basic program has to be extended in two major ways:

1. The routine for extracting data from gpx file must be extended to also capture elevation data (delimited by `<ele>` & `</ele>` tags).
2. A new routine must be written to identify the 1km splits and produce the summary statistics for each split.

Additional Notes

- The data files should be placed in a folder `inputFiles`.
- Since different data files will result in different numbers of splits it makes sense to introduce a new list structure to store the splits data.
- The distance travelled between successive data points in the gpx file may be several metres. It is not necessary to interpolate between data points in order to identify the exact split point. The first data point after the split point can be used for calculations.
- The function `readDoubleAfterToken` can be used to get the elevation data as the file is being read.
- The functions `timeStructFromString` and `timeDiff` should be usable for calculating the split times.

B. Code Design Requirements

- Similar to assignment 1 and 2, you should:

- **Create functions where appropriate.** As part of the assessment, some marks will be given for how your code is organised. So if it makes sense to create a function for some subtask of the bigger problem, then you should.

C. Your Submission

1. Create a new project.

In eclipse, create a new C project called “*GPSAnalyse*”. Create a copy of `GPSAnalyseBasic.c` that will hold your solution to this assignment.

2. Document your code.

You must comment your solution as follows:

1. You should include a short comment at the start of your main c source file, which describes generally how the code works (e.g. describe inputs for the game etc).
2. For each function, you should describe (in a few sentences) the purpose of the function, any parameters of the function and possible return types the function may have.

3. Submitting your solution.

Submissions should include the C source file and a text or pdf file showing sample runs of the program.

D. Sample Runs

Some implementation decisions may result in results that are *slightly* different to these.

1. Run4.9k.gpx

---Overall Statistics---

Path Length: 4901 m

Total time: 1663 sec

Average Pace: 5.66 m/km

-----Splits Statistics-----

Split No.		Pace m:s		Speed km/h	Elevation m

1		5:59		10.02	2
2		5:27		10.98	10
3		5:09		11.62	-9
4		5:13		11.47	-9
5		6:31		9.21	3

-----Splits Statistics End-----

2. Howth-Cross.gpx

---Overall Statistics---

Path Length: 24468 m

Total time: 9893 sec

Average Pace: 6.74 m/km

-----Splits Statistics-----

Split No.		Pace m:s		Speed km/h		Elevation m
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1		5:41		10.53		-0
2		7:01		8.54		46
3		5:56		10.10		11
4		6:03		9.92		12
5		6:48		8.81		45
6		7:48		7.68		3
7		3:29		17.20		-38
8		3:25		17.53		-69
9		10:29		5.72		60
10		9:03		6.63		40
11		9:07		6.57		10
12		4:24		13.61		-33
13		3:47		15.81		-30
14		5:16		11.38		-5
15		3:07		19.20		-49
16		8:25		7.13		34
17		6:42		8.94		16
18		7:46		7.72		37
19		8:22		7.17		35
20		5:47		10.37		-45
21		5:06		11.75		-73
22		11:46		5.10		68
23		12:07		4.95		22
24		4:49		12.44		-74
25		5:13		11.48		-12

-----Splits Statistics End-----