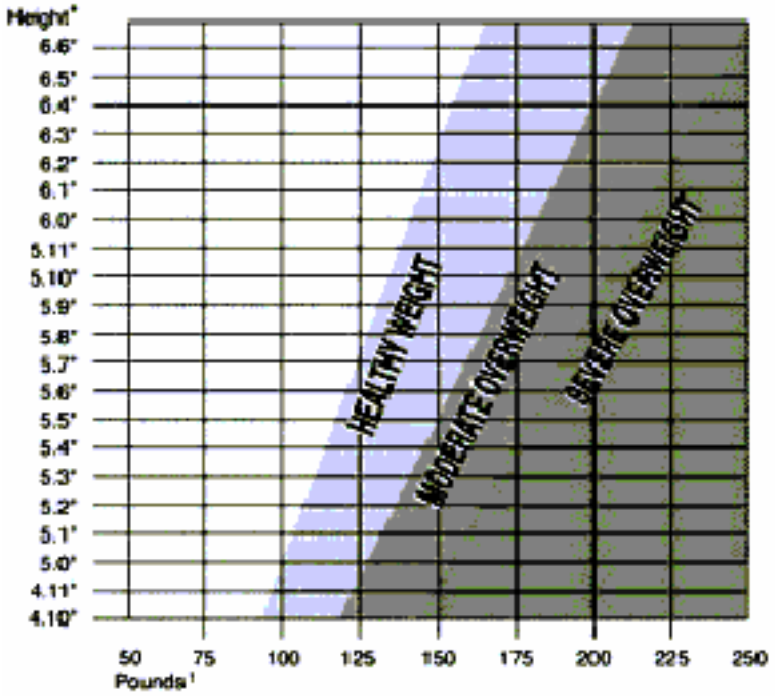
Problem set 1: Applications software for the biomedical research laboratory or medical facility

Please turn in one of these exercises on a PC-compatible floppy disk within three weeks (by Wednesday, October 10). Note that the exercises must be selected on the distribution sheet circulated in class: no more than 3 should sign up for any one problem. These exercises involve processing one of the data sets provided on the website as raw text files: any of the five data sets can be downloaded as a .txt file and accessed by your program. Be sure to save the data files as raw text, NOT as .doc files. Please use any useful VB objects like message boxes, input boxes, menus, command buttons, list boxes, combo boxes, option buttons, etc. as appropriate for creating the most effective and unambiguous graphic user interface you can produce.

Each of the five exercises to be done in the course, including this one, is worth 25 points, based on the following values: Does the program follow the specifications and description provided in the statement of the problem? (5 points). Does the program run without crashing and provide the expected output? (10 points). Is the Graphical User Interface well designed and easy for the user to understand? (5 points). Are your documentation and comments adequate? (5 points) Was the exercise turned in on time? (5 bonus points) You are expected to work on these assignments independently - no clones of exercises written by others, please. The disk you turn in should be labeled clearly with your name, problem set number and exercise name (shown in parentheses below). Be sure to keep backups of all your work in case your disks are lost or damaged!

Patient File Data: The data in DataSet1.txt represent simplified medical record files. Record format is: patient i.d. number (4 digit), name (first name space middle initial space last name), street address, city, state space zip, physician name, insurance company, insurance policy code or social security number, gender (M or F), date of birth, weight (in lb), height (in inches), systolic BP (mm Hg), diastolic BP (mm Hg), serum cholesterol (mg/100 ml)

1. (weight) Identify by name all patients who appear to be moderately overweight and severely overweight, using the standard height-weight graph shown below
2. (medicare) Identify by name all patients who are eligible for Medicare.
3. (hyperchol) Identify by name all patients who are hypercholesterolemic (ser. chol. >240).
4. (wtbpchol) Display a list of the range (highest and lowest values) of recorded patient weights, blood pressures, and cholesterol levels.
5. (nonresunins) Use the original file to generate two new separate lists: (a) the names of any out-of-state residents, and (b) the names of patients who are uninsured.



Research Lab Data: The second file ("DataSet2.txt") consists of raw text data showing the shortening kinetics of an isolated cardiac cell. The file consists of 1,313 data points, with 101 data points in each of 13

contiguous (unparsed) contraction records of 12 sec duration. The first column shows the sampling time in 0.01 sec intervals, from –0.05 sec to 0.95 sec, with application of the stimulus at 0.00 sec. In other words, the first six data points of each record, from -0.05 to 0.00 sec, are "pre-stimulus" measurements of the length of the cell in diastole before contraction begins. The second column is a voltage proportional to the cell's length (the calibration factor is 0.20 μm/millivolt and the resting length of the cell was 98.5 μm)

6. (timetopeak) Measure the "TTP" or time to peak shortening for each of the shortening records. Show the 13 values (say, in a listbox) and the average value (say, in a separate textbox)
7. (relaxtime) Average the thirteen records; show the averaged record and measure the relaxation half time, defined as the time at which peak shortening has decayed to half its maximum value.

Clinical Lab Data: the next exercises involve processing a collection of patient records, which might have been generated from a hospital clinical laboratory. The records labeled as DataSet3.txt are to be used for these exercises. The file provides a standard clinical chemistry "patient profile" readout from a clinical analyzer (like the Technicon Corp. SMA 12/60) indicating patient serum concentrations of important metabolites, enzymes and other solutes.

Each of the fifteen records saved in DataSet3.txt consists of patient name (last, first), patient number (5 digit), attending physician's name, lab number (6 digit), date, followed by values for the following assays: calcium (mg/dL, or milligrams per deciliter), phosphorus (mg/dL), glucose (mg/dL), BUN (blood urea nitrogen) (mg/dL), uric acid (mg/dL), cholesterol (mg/dL), total protein (g/dL), albumin (g/dL), bilirubin (g/dL), alkaline phosphatase (in milliunits per ml, or IU/L), LDH (lactic dehydrogenase, in mU/ml, or IU/L) and SGOT (serum glutamic oxaloacetate transaminase, in mU/ml). The first two records, 001 and 002, are not patient records, but provide the upper and lower bounds for "normal" ranges for these assays. A sample record looks like this:

Smith, Sam, 03572, J. Wallace MD, 096345, 5-19-88,
9.6,4.1,110,3.5,225,7.1,4.5,1.1, 65,140,30

Some of the patients show abnormal serum levels 20% or more above or below "normal" range.

8. (patnameorno) Write a program to display a patient's record, given either the patient's name or number.
9. (allabnormal) Write a program to examine all patient records, and to display the names of any patients having test values above or below the "normal" levels provided in your file as record numbers 001 and 002. Display appropriate alert messages such as "CAUTION! abnormal BUN level = nnn! Normal range = nnnn to mmm."
10. (enternewrecords) Write a program to allow the entry of additional patient records, and storage of the entire patient data file on your disk. Your program should allow for correction of any part of the newly entered record before it is saved on the disk, without having to reenter the entire patient record.
11. (sortphysician) Resave the patient records on your disk as two new separate files, sorted by the name of the attending physician (either Wallace or Jones).

Research Lab Data: nine waveforms are stored in the text file DataSet4.txt; each waveform consists of 150 three-digit numbers recorded from a microforce transducer system monitoring the tension (approx 0.25 milligram peak) produced by an electrically paced, living cardiac cell. The nine waveforms are contiguous and the boundary between one record and the next is not marked in any way. The magnitude of force generated by a single heart cell is quite low and the measurements are contaminated with random electronic noise.

12. (ninetwitches) Read each data record 1 through 9; display each of the 9 records on the screen in a 3 by 3 display window matrix. Number each record 1 through 9.
13. (smoothtwitches) Smooth any one of the nine waveforms using a three point smoothing function of the form $a_i = (a_{i-1}+2*a_i+a_{i+1})/4$ and superimpose the smoothed waveform on the original waveform display.
14. (averagetwitches) Signal averaging: average the 9 original waveforms to produce an appropriately scaled new waveform. Superimpose a display of the averaged signal on top of the 9 original images; distinguish the averaged waveform display (the calculated points) from the original data points using a different color.

Research Lab Data: Records stored in the text file DataSet5.txt consist of evoked waveforms recorded directly from a Photon Technology Inc. Fluorescence Calcium Ratio measurement system detecting the free calcium ion transient produced in an electrically paced cardiac cell loaded with the dye Indo-1. The records represent the ratio of the fluorescence signals recorded by the photomultiplier tubes monitoring 405 and 485 nm fluorescence emission (free and bound calcium ion) and are quite weak in strength (counting 10s of photons per sample); signals are plagued by random noise. The data consist of a time record (0.05 sec sampling interval) and the calcium ratio signal. There are 528 data pairs, 26.35 sec of recorded data, with 8 waveforms total.

15. (averagecasignal) Signal averaging: display a trace representing the average of all 8 original waveforms with a trace of any single waveform.
16. (smoothcasignal) Smooth and overlay each waveform using a three point smoothing function of the form $a_j = (a_{j-1}+2*a_j+a_{j+1})/4$.