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Exercises to
Introduction to Embedded Systems
Summer term 2010

Assignment 9

(10 Points)

Deadline is Monday, July 5, 2010, 16:00

9.1 Integer linear programming (2 Points)

Define the general form of an integer linear program. Which form must the cost function and the constraints have? Briefly explain its components.

9.2 Static SPM allocation (5 Points)

Given a system with a main memory and a single additional scratchpad memory (SPM). Also given the following tables defining the energy consumption per access to each memory and the variables with their respective access counts in an executing program:

Type	Size	E/access
Scratchpad	4096 (4k)	1,3 nJ
Main memory	262144 (256k)	31 nJ

Variable	Size	Accesses
a	1024	16
b	2048	1024
c	512	2048
d	256	512
e	128	256
f	1024	512
g	512	64
h	256	512

Which variables should be assigned to the SPM so that the program is executed with minimal energy consumption?

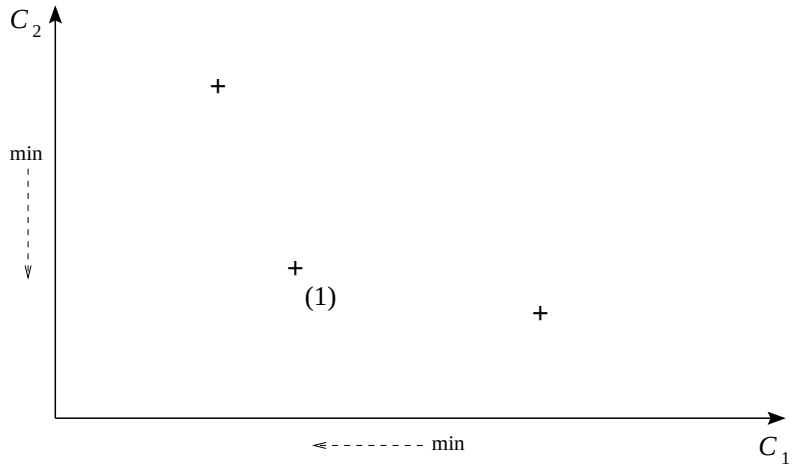
Solve the problem with the help of an ILP model. Specifiy the ILP model as well as the result of the optimal solution. You may solve the problem any way you prefer. There is no need to specify intermediate steps.

Hint: The abstract problem from which the SPM allocation is derived is called the 0/1 knapsack problem. Given a knapsack with a maximum weight W, a set of objects $n \in N$, a value $v(n)$ and a weight $w(n)$. Maximize the value of the knapsack by deciding whether an object is placed into it while not exceeding W. A generalized version of the SPM allocation has been discussed in the lecture. You can use the open ILP solver *lp_solve* or some spreadsheet editor that comes with a built-in solver (like Excel or Calc) to solve it.

(Turn around . . .)

9.3 Pareto Points (3 Points)

The following diagram depicts the evaluation of designs with respect to two different criteria C_1 (e. g. memory usage) and C_2 (e. g. energy dissipation). Both criteria should be minimized.



In the diagram, mark the area which is dominated by solution (1), i. e. mark all those alternative designs which are "worse" than design (1). Also, mark the area in which solutions would dominate design (1).

General notes:

Dates and additional information can be found at `http://ls12-www.cs.tu-dortmund.de/en/teaching/courses/ss10/ies/`. The assignments will be published **Tuesdays** on a weekly basis and have to be solved until the next **Monday**. Drop your sheets into the mailbox in OH16 right across the secretariat (E22) or send an e-email to your tutor. In the latter case, the submissions must be of either **PDF** or **PS** format. To pass the labs a minimum of 60% of the total points must be achieved.