Heidelberg University
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Computer Engineering Group

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GPU Computing - Architecture and Programming
Winter Term 2025/2026

Exercise 1

- **Hand in via Moodle until 09:00 on Wednesday 22 October, 2025**
- **Include all names on the top sheet. Hand in a single PDF.**
- **Please employ the following naming convention `gpu<XX>_ex<N>.{zip,tar.gz}`, where `XX` is your group number, and `N` is the number of the current exercise.**
- **A maximum of 4 students is allowed to collaborate on the exercises.**
- **In case an exercise requires programming:**
  - **include clean and documented code**
  - **include a Makefile for compiling**

1.1 Reading

Read the following two papers and provide reviews:

- Leslie G. Valiant. 1990. A bridging model for parallel computation. Commun. ACM 33, 8 (August 1990), 103-111.
- W. J. Dally, S. W. Keckler and D. B. Kirk. 2021. Evolution of the Graphics Processing Unit (GPU). IEEE Micro, vol. 41, no. 6, 42-51.

(10 points)

1.2 Amdahl's Law

1. Derive Amdahl's Law.
2. Comment on the correctness of this law regarding real applications. Is it accurate in its prediction, or reporting too high or too low performance? Provide examples for the last two cases.
3. (a) Calculate the overall speedup using Amdahl's Law
     - $P = 0.5$ (50% of the program can be parallelized).
     - $N = 4$ (number of processors).

   (b) Calculate the overall speedup if the number of processors is increased to 8.
     - $P = 0.2$ (20% of the program can be parallelized).
     - $N = 8$ (number of processors).

   (c) Compare the results. What can you conclude from this comparison?

(10+6 points)

1.3 Willingness to present

Please declare whether you are willing to present any of the previous exercises.
The declaration can be made on a per-exercise basis. Each declaration corresponds to 50% of the exercise points. You can only declare your willingness to present exercises for which you also hand in a solution. If no willingness to present is declared you may still be required to present an exercise for which your group has handed in a solution. This may happen if as example nobody else has declared their willingness to present.

- Reading (section: 1.1)
- Amdahl's law (section: 1.2))

(13 points)

Total: 39 points