Massively Parallel Algorithms
Organisational Stuff

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What You (Hopefully) Get Out of This Course

- Most importantly: *mind set* for thinking about massively parallel algorithms
- Overview of some *fundamental* massively parallel algorithms
- Techniques for massively parallel *visual computing*
- Awareness of the *issues* (and solutions) when using massively parallel architectures
- Programming skills in *CUDA* (the language/compiler/frameworks for programming GPUs)

Is This Course For Me ???

- This course is not for you ...
  - If you don’t like algorithms
  - If you are not ready to do a bit of programming in C
    - The concept of *pointers* should be familiar
  - If you're not open to thinking about computing in completely new ways

Otherwise ...

- It will be a richly rewarding experience!

Website

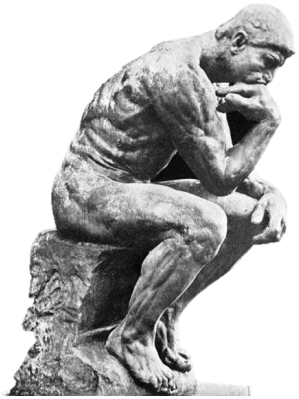
- All important information about this course can be found on:

  http://cgvr.informatik.uni-bremen.de/

  → "Teaching" → "Massively Parallel Algorithms"
- Slides
- Assignments
- Text books, online literature
- Please sign up in StudIP!

Exercises / Assignments

- The two approaches we will pursue in this course:



- Bi-weekly small exercises
  - Recommended: work on them in groups of 3+-
  - Skeleton program from us
  - Language CUDA/C++

- Grading criteria of the exercises:
  1. "Labeling" variable and function names
  2. "Sufficient" comments in body of functions
  3. Documentation of functions and their parameters (in/out, pre-/post-condition, what does the function do / not do, ...)
  4. Functionality (exercise solved? no bugs? ...)

Documentation: minimum

```
// Convert HSV color space to RGB
// input:  h must be in [0,360); s,v must be in [0,1]
// output: r,g,b (out) will be in [0,1]
// Warning: no parameter range checks are done!
__device__
void HSVtoRGB( float *r, float *g, float *b,
               float h, float s, float v )
{
```

Documentation: better

```
/**  Compute point nearest to q and on an edge of SIG
 *
 * @param q             the current query point
 * @param points        the point cloud
 * @param delaunay      delaunay diagram of the point cloud
 * @param pstar         NN of q (out)
 * @param pstar2        neighbor of pstar (in SIG) (out)
 * @param phat          point closest to q on edge (pstar,pstar2) (out)
 * @param d             distance between q and phat (out)
 *
 * @warning
 *   Assumes that a SIG has been computed!!
 * @bug
 *   Bis jetzt ist pstar2 nur NN zu pstar im Delaunay-Graph, nicht im SIG!!
 **/

void nearest_on_graph( const FPoint & q, const std::vector<FPoint> & points,
                       const Proximity & proximity,
                       unsigned int * const pstar, unsigned int * const pstar2,
                       FPoint * const phat, float * const d )
{
```

The SDK, Needed for Working at Home

- IDE (obviously) of your choice
  - Can be as simple as an ASCII editor and compiler on command line
- CUDA for your platform:

  https://developer.nvidia.com/cuda-downloads
  - Works, of course, only with NVidia graphics cards
  - If your laptop/desktop does not contain NVidia, use the pool or our lab

Overall Grades & Examinations

- You have two options:
  1. *Regular oral exam*, ca. ½ hour per student
  2. *Mini oral exam* (so-called "Fachgespräch"), ca. 10 minutes per student

- The formula for calculation of your grade with option 2:
  - Assignments ⟶ grade A
    - 95% of all points ⟶ A = 1.0
    - 40% of all points ⟶ A = 4.0
  - Mini oral exam ⟶ grade B
  - Overall grade $= \min\left\{\frac{1}{2}\cdot(A+B),\ B\right\}$ ("min" means "better of the two")
    - Under the condition: A ≥ 4.0 && B ≥ 4.0 !

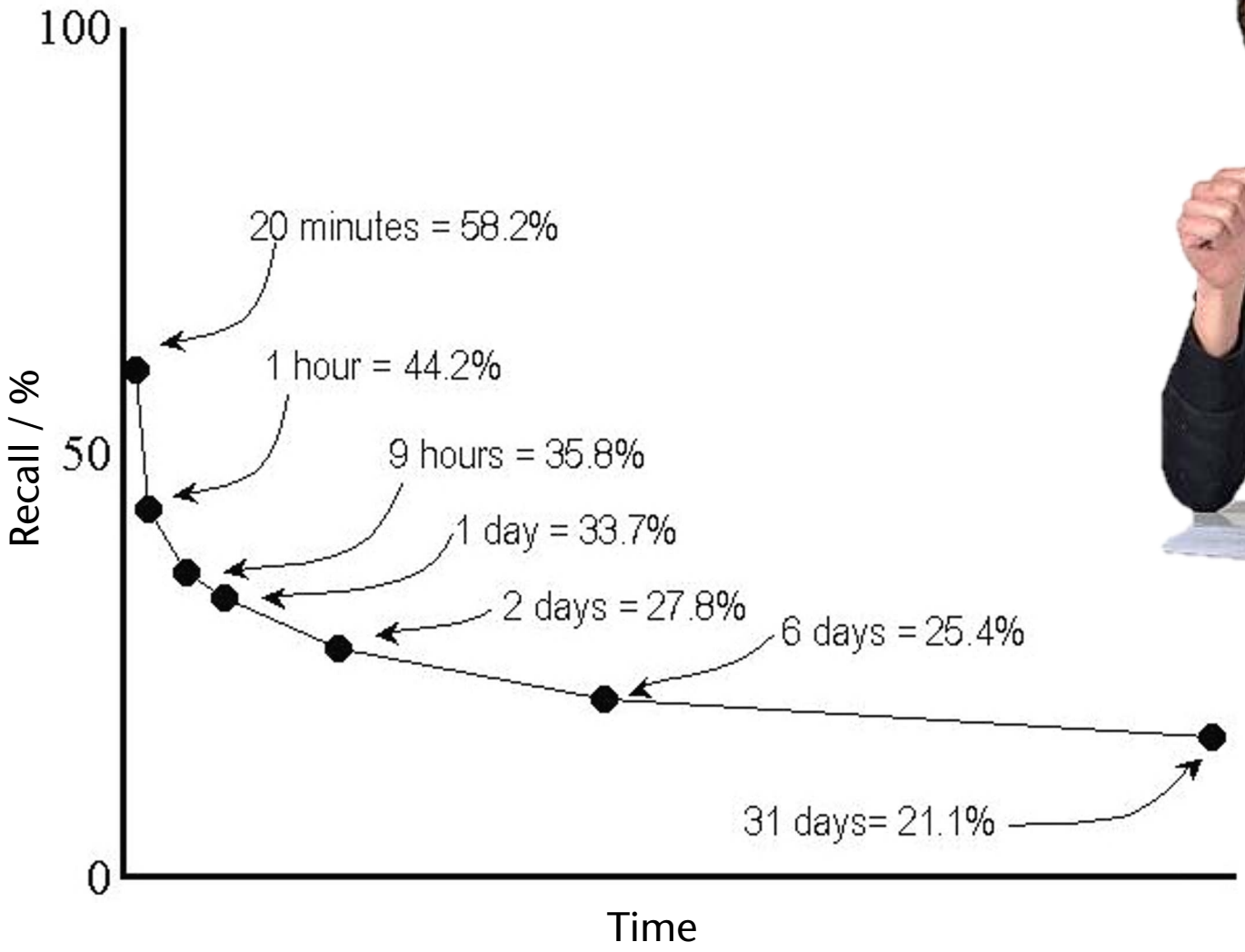
- Note: in both cases, *all of the material could be topics for the exam*!

A Quote

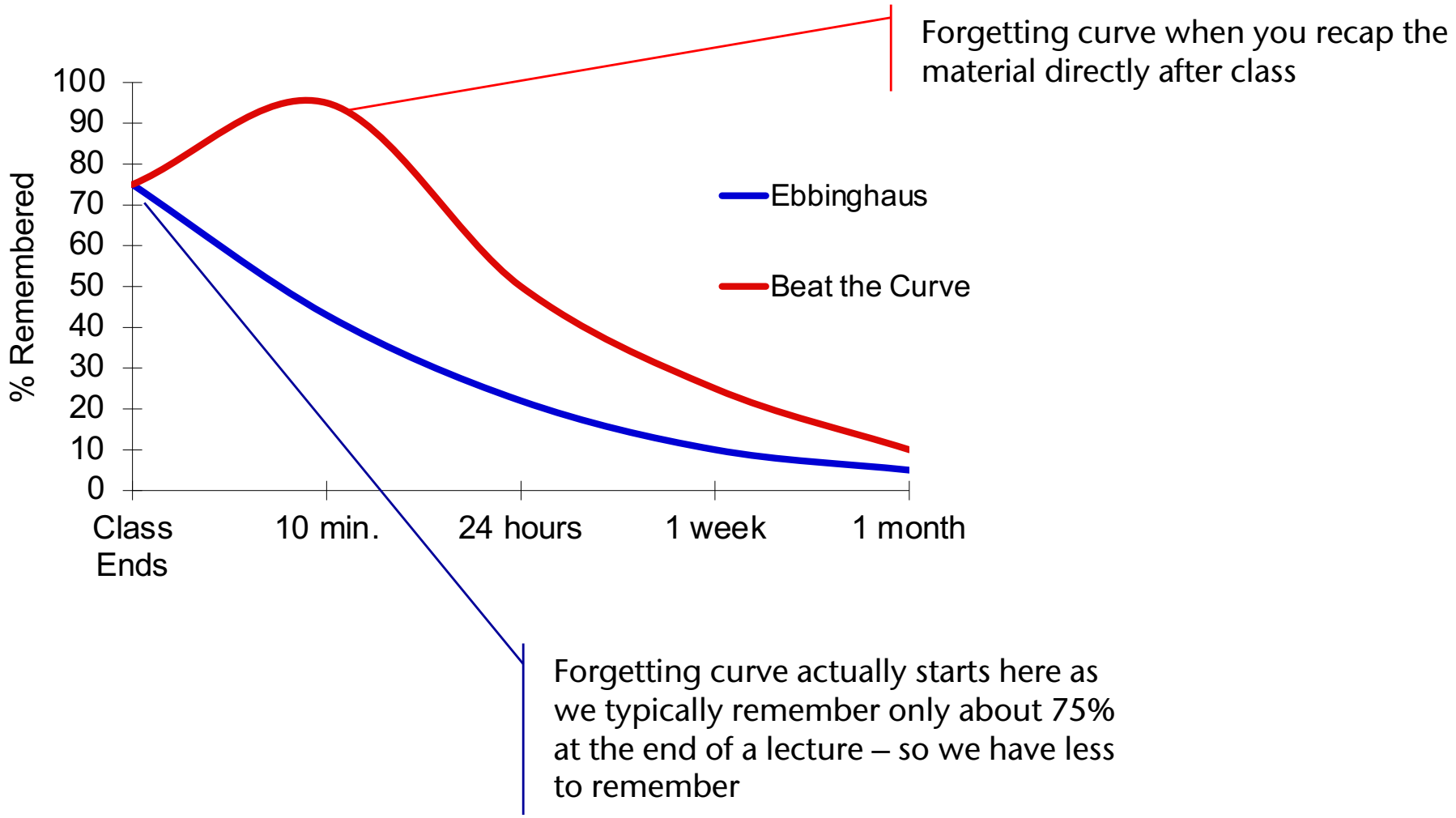
I hear and I forget.
I see and I remember.
I do and I understand.

[Attributed to Confucius]

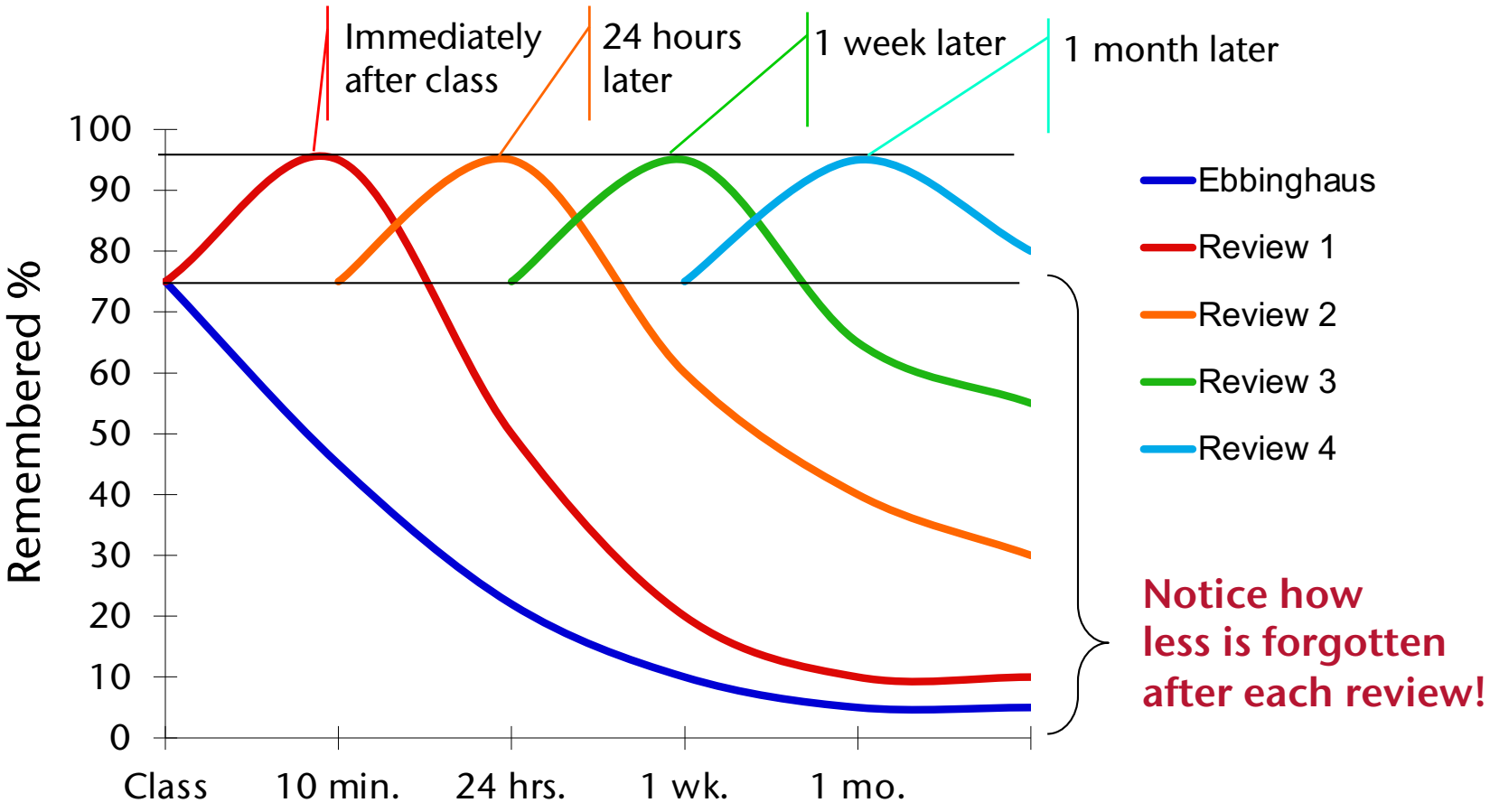
The Forgetting Curve (Ebbinghaus)



Beating the Forgetting Curve



Overcoming the Curve



Average Retention Rates

Just listening	5%
Reading	10%
Audio Visual	20%
Demonstration	30%
Discussion	50%
Practice by doing	75%
Teach others	90%