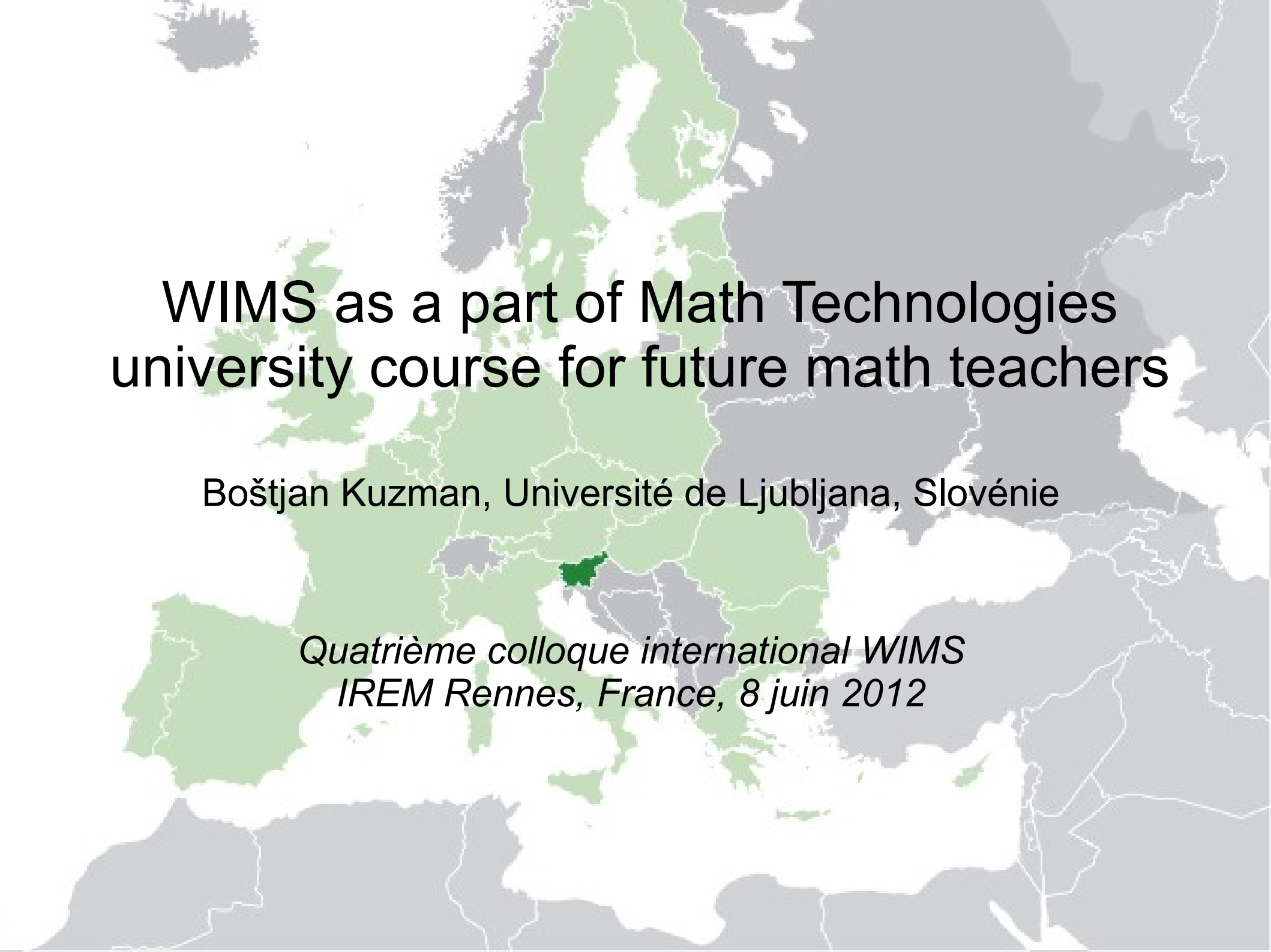

WIMS as a part of Math Technologies university course for future math teachers

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General state of ICT in Slovenian schools

- Primary (6-14) and secondary (15-18) schools are well-equiped with computers, beamers, interactive whiteboards,...
- Most schools have Moodle or similar LMS setup locally.
  Its actual use depends on individual teachers.
- Considerable amounts of money were spent in past 10 years to create and promote „interactive teaching materials“, etc.
- Politicians & Opinion makers: Technology makes the learning so much more effective and fun. (Cheap) e-books should replace (costly) printed books.
- Proffessional commercial publishers hesitate to respond to such calls (small market, copyright questions).
- Some pilot projects using tablets with ebooks in the classroom were started recently.

Personal WIMS activities log

- **2003/4:** The first Slovenian user?
  - Occasional use of some WIMS tools in a 1st year University course of Linear algebra
- **2004/5:** Started using WIMS virtual classrooms regularly
- **2005/6:**
  - Slovenian WIMS translation (basic modules)
  - Local server set up at http://wims.pef.uni-lj.si
- **2006/07:**
  - Two public presentations at professional meetings on national level
  - Organized a 24-hrs WIMS usage course for teachers
  - More translations and original WIMS modules created
  - Attended the 2nd WIMS colloque in Nice

Current state of WIMS in Slovenia

- No translation updates since 3.5x.
- Local server wims.pef.uni-lj.si down.
- WIMS virtual classrooms are being used in 2 courses (Linear algebra, Logic and sets) for math education students at the Univ. of Ljubljana, Faculty of education.
- Since 2010/11, we cover some WIMS related topics in a regular „Mathematical Technologies“ for 2nd year students (Bsc level).

The Math Technologies course

- Since 2010/11.
- Audience: 25-40 students in the 2nd year of the university programme for future teachers of mathematics in primary school (11-14) or in profession-oriented secondary school (15-18).
- 1 semester (15 weeks, 3hrs/week).
- Topics covered this year:
  - math publishing (LaTeX),
  - computer algebra systems (Maxima),
  - geometry (GeoGebra),
  - interactive environments (WIMS).
- No use of closed, commercial solutions!

WIMS topics covered in the course

(Note that the students have already met WIMS before in their Linear algebra course.)

- Exploration of tools and other existing materials.
- Classroom creation & basic maintenance.
- Translating examples and creating simple OEF exercises with random parameters via Createxo.
- Worksheet creation and grading.
- **Final project:** students create some exercises, make them available on their worksheets, and write a report.

Main observations

- WIMS architecture embraces different types of software – one has to interconnect.
- The students find the topics very useful in practice. However, software may change before these students actually start to teach!
- The feeling of creativity: modifying existing and creating new exercises to suit one's personal teaching style is often more rewarding than just following some prepared set.
- Regardless to ocassional frustrations (OEF programming), the students actually like the course a lot!
- Creating a good exercise with random parameters can also be a great exercise in mathematical thinking.

Example: Intersection of lines

Line 1: y=ax+b
Line 2: y=cx+d

Compute the intersection point P!

(if the lines meet)

How to randomize parameters (1)

a,b,c,d = randint[-5..5] works, but...

- For beginners, one may require unique intersection and integer coordinates of P.

  Solution: Choose random integer coordinates for P=(p,s) and take rows of random non-singular 2x2 matrix for direction vectors of your lines (use SLIB).

How to randomize parameters (2)

- At next stage, solutions **MUST** be noninteger!

  Again, a,b,c,d = randint[-10..10] works, but not perfectly:

  - Lines can happen to overlap or not intersect.
  - P can happen to have integer coordinates.

- Possible solutions:
  - Use conditionals to fix „bad“ random choices.
  - Apply „nice random transformations“ to some „good“ nonrandom choice of parameters to give fake impression of randomization.

How to randomize parameters (3)

- Intersection should not be (always) unique!
  - But with a,b,c,d = randint[-10..10], the probability of parallel lines is very small.
  - Possible solutions:
    - Force the „uniform“ distribution of parallel / nonparallel case?
    - Assign a lot of repetitions?

WARNING!

„Thus, a teacher of mathematics has a great opportunity. If he fills his allotted time with drilling his students in routine operations he kills their interest, hampers their intellectual development, and misuses his opportunity.„

G. Polya, 1948, in the preface to his book *How to Solve It*?

Imitating a good teacher

- Start with a simple case.
- Gradually increase computational difficulty.
- Each succesful attempt should raise new questions.
- Methods and answers are not always uniquely determined.
- Etc.

But: once this is really perfected, technology will replace human teachers?

Conclusion

- I find some aspects of WIMS really great and useful, both for use in math classes as for getting acquainted with technology for teaching.
- As a topic in Math Technology course, I like its „non-trivial“ aspects. A math teacher should have some basic understanding of how such systems work.
- Fear of overusing:

  get data -> compute -> enter solution -> receive a grade

  is not the „art“ of mathematics.

„The“ questions

- What kind of math do we want to teach?
  - The one best suited for technology? NO!
- (How) Does the use of technology influence the contents we teach?
- (How) Does the use of technology and internet influence the development of mathematical thinking?
  - An interesting perspective:
    The Shallows. What the Internet is Doing to Our Brains,
    a popular science bestseller by N. Carr, 2011.

The crutch

(a story by the jesuit priest A. De Mello)

- In some village, a boy is born with no legs.
- He learns to walk with a crutch.
- Other kids imitate his moves.
- The art of using a crutch is passed to their children.
- In few generations, no one can walk without a crutch anymore.

The crutch (continues)

- One day, a new boy announces he would try to walk without a stick...

- **He fails. Thus, it's impossible!**
- No one ever tries to walk without a stick again.

Thank you for attention!