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Final Year Project Ideas, Sem 1 '17/'18

My interests are in the area of **computational mathematics**, and, in particular, algorithms for

- (a) solving differential and integral equations (Numerical Analysis)
- (b) solving linear systems and estimating eigenvalues (Numerical Algebra).

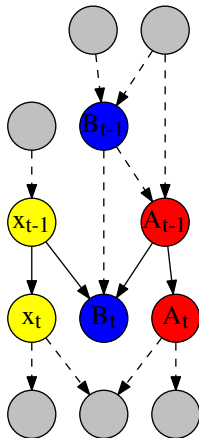
I am interested in supervising any project that involves

- ▶ some differential equations and/or linear algebra;
- ▶ theoretical or practical computing;
- ▶ applications from economics, finance (or any other area of human endeavour).



Example

1. Identify a interesting differential equation model.
See, e.g., *Application of Alternative ODE in Finance and Economics Research*, Junmin Shi.
2. Devise a suitable method for solving the problem (e.g., might involve a specially designed ODE method, or adaptive time-stepping). ← symbolic computing very useful.
3. Identify a data set for validating the model, or estimating its parameters.
4. Incorporate data into model to yield specialist approach. Tools one could use:
 - ▶ **PROFET: a Probabilistic Framework Based on Mathematical Models**;
 - ▶ **A Kalman Filter**, see, e.g., Humpherys, Redd & West. *A Fresh Look at the Kalman Filter*, SIAM Rev., 54(4), 801–823.



Other ideas

- ▶ Pedro Freitas. *Optimal Ball Placement in Rugby Conversions* SIAM Rev. 56-4 (2014), pp. 673-690. <http://dx.doi.org/10.1137/130913225>
- ▶ Gilbert Strang and Shev MacNamara. *Functions of Difference Matrices Are Toeplitz Plus Hankel*. SIAM Rev. 56-3 (2014), pp. 525-546. <http://dx.doi.org/10.1137/120897572>
- ▶ Bryan and Leise. *Making do with less: an introduction to compressed sensing*. SIRev 55(3):547-566, 2013.
- ▶ Kepner and Gilbert. *Graph Algorithms in the Language of Linear Algebra*
- ▶ Matousek, *Thirty-three Miniatures (Applications of Linear Algebra)*
- ▶ Gleich. *PageRank beyond the web*. SIRev 57(3):321-363, 2015.
- ▶ Vanderbei et al. *A Regression Approach to Fairer Grading*. SIRev 56(2):337-352, 2014.