

Mining Recurrent Activities: Fourier Analysis of Change Events

Abram Hindle, Michael W. Godfrey, Richard C. Holt

Software Architecture Group

David R. Cheriton School of Computer Science

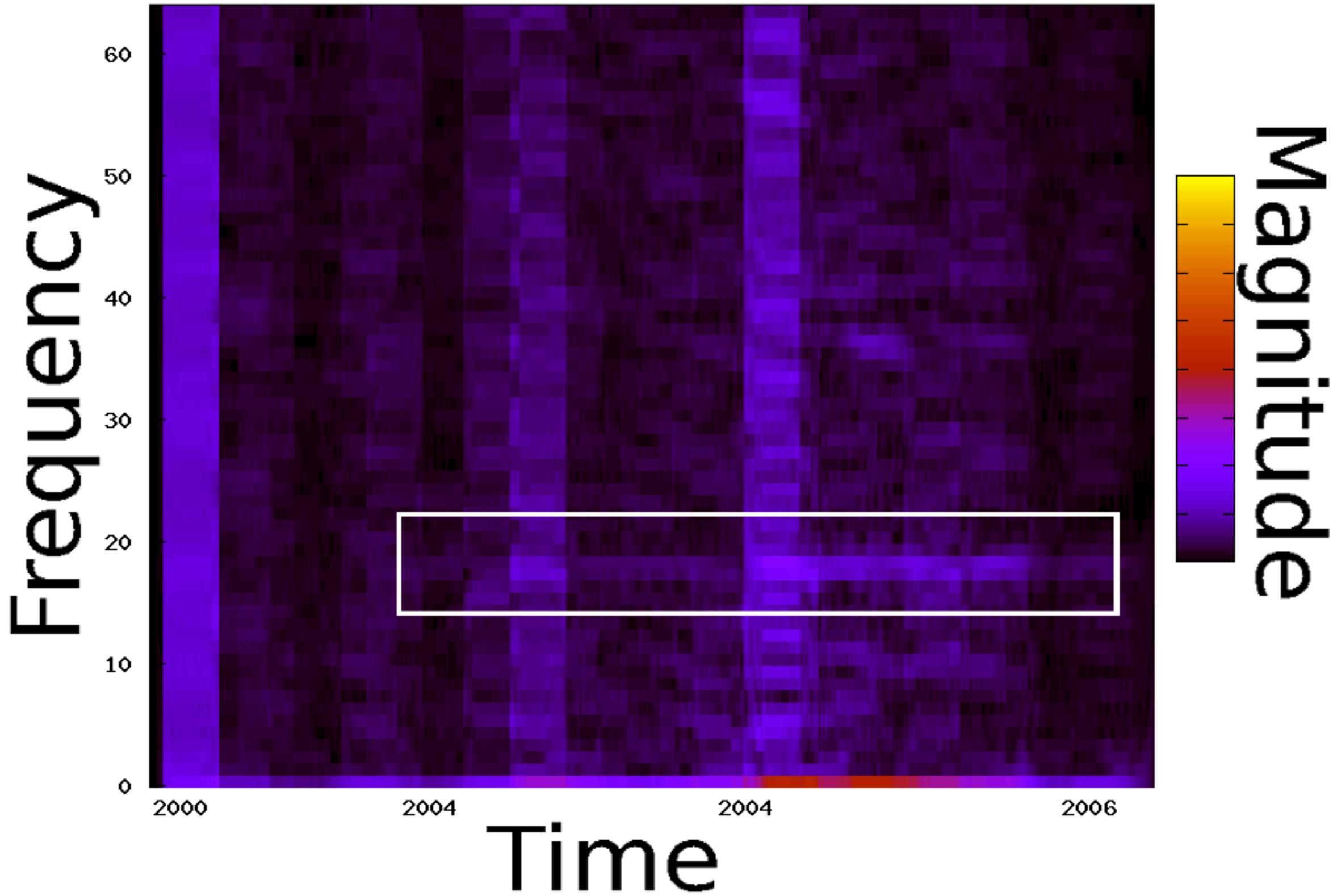
University of Waterloo

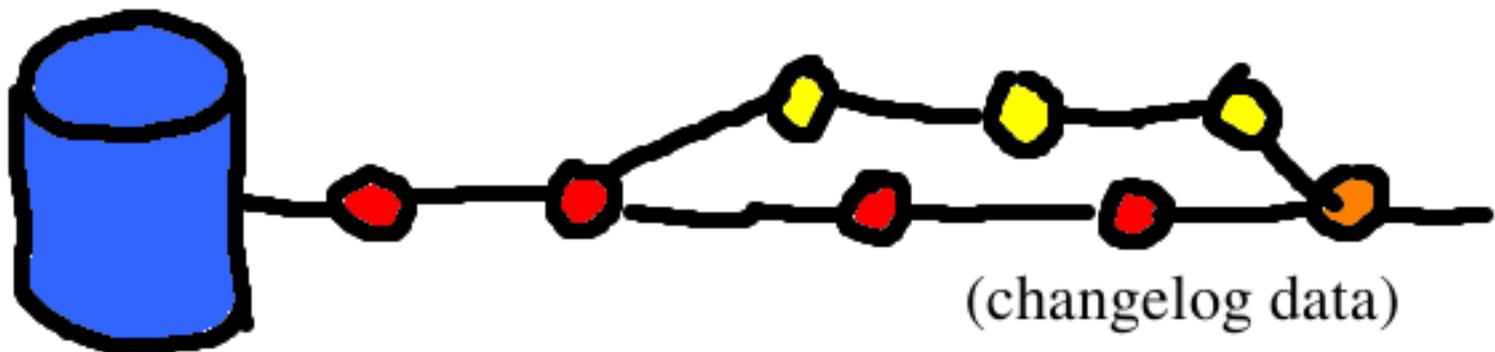
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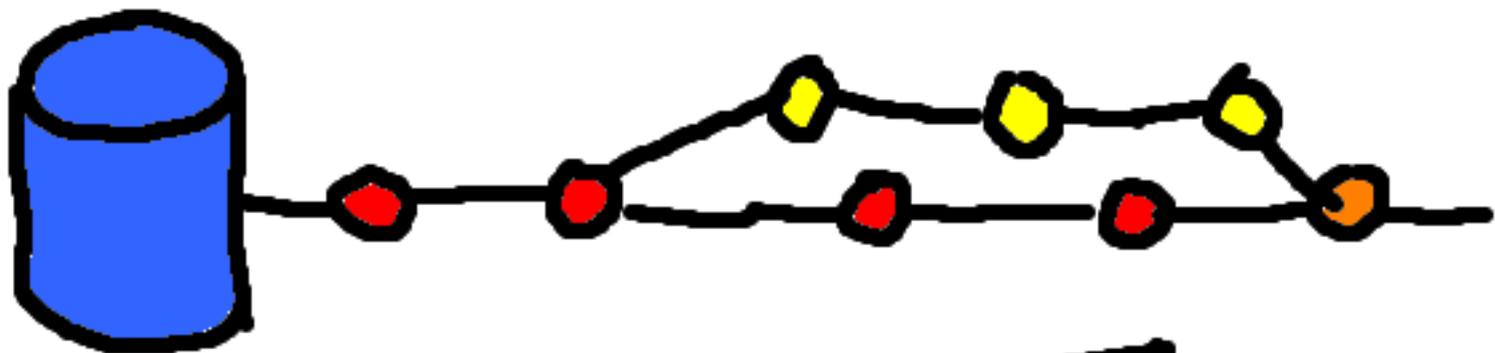
<http://swag.uwaterloo.ca/>

{ahindle,migod,holt}@cs.uwaterloo.ca

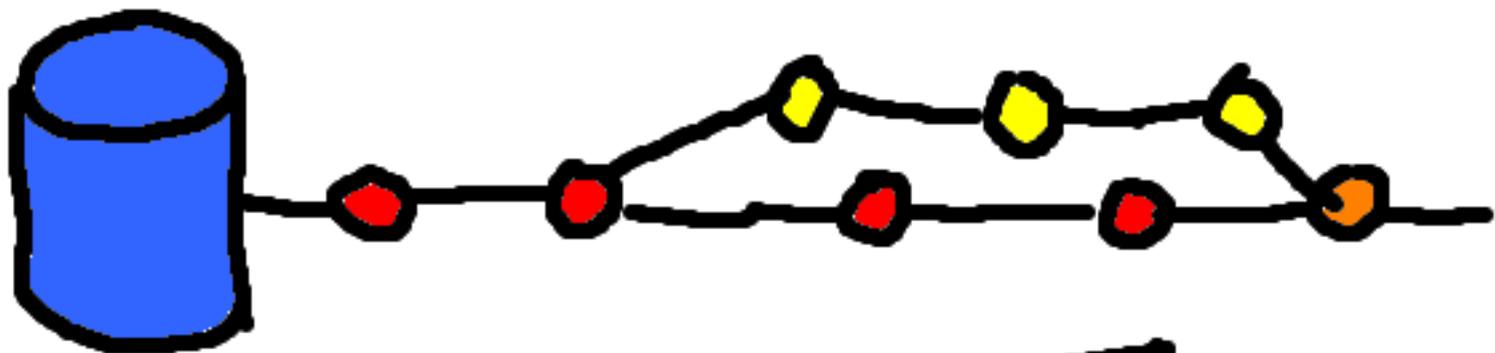
Fourier Transform of MySQL 5.0



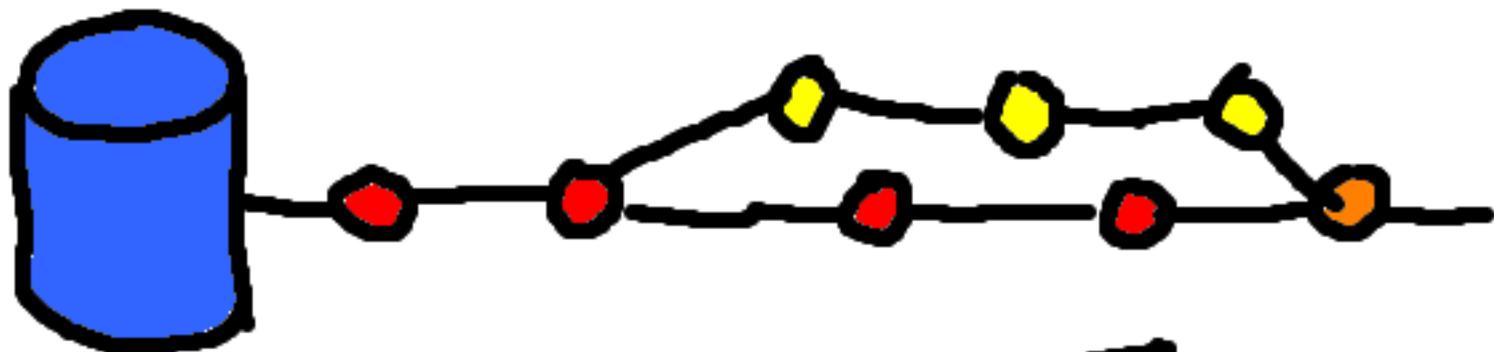




(mailing lists)



(process logs)



(hotspots/profiler)





Developers

create

software

together

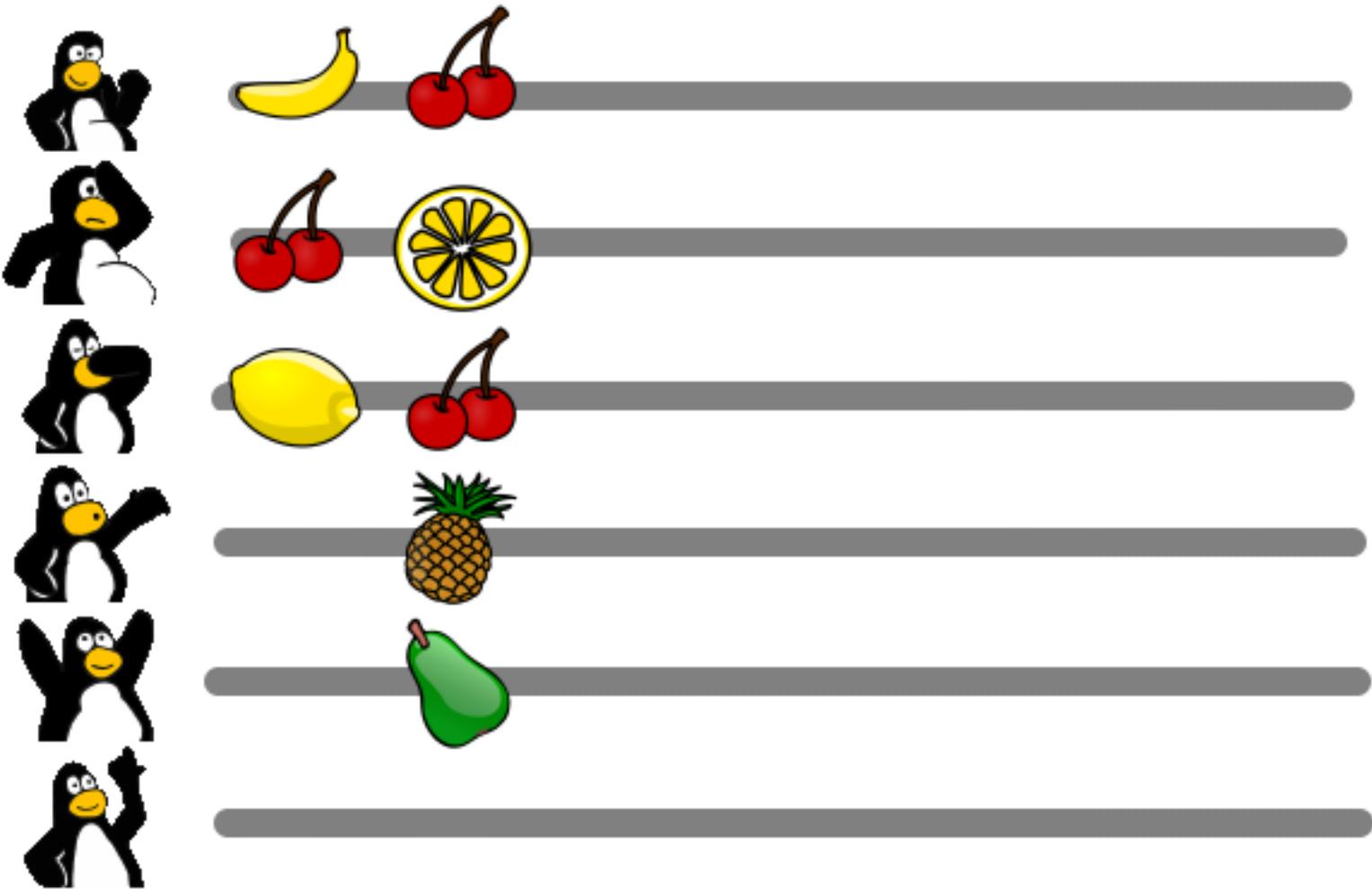




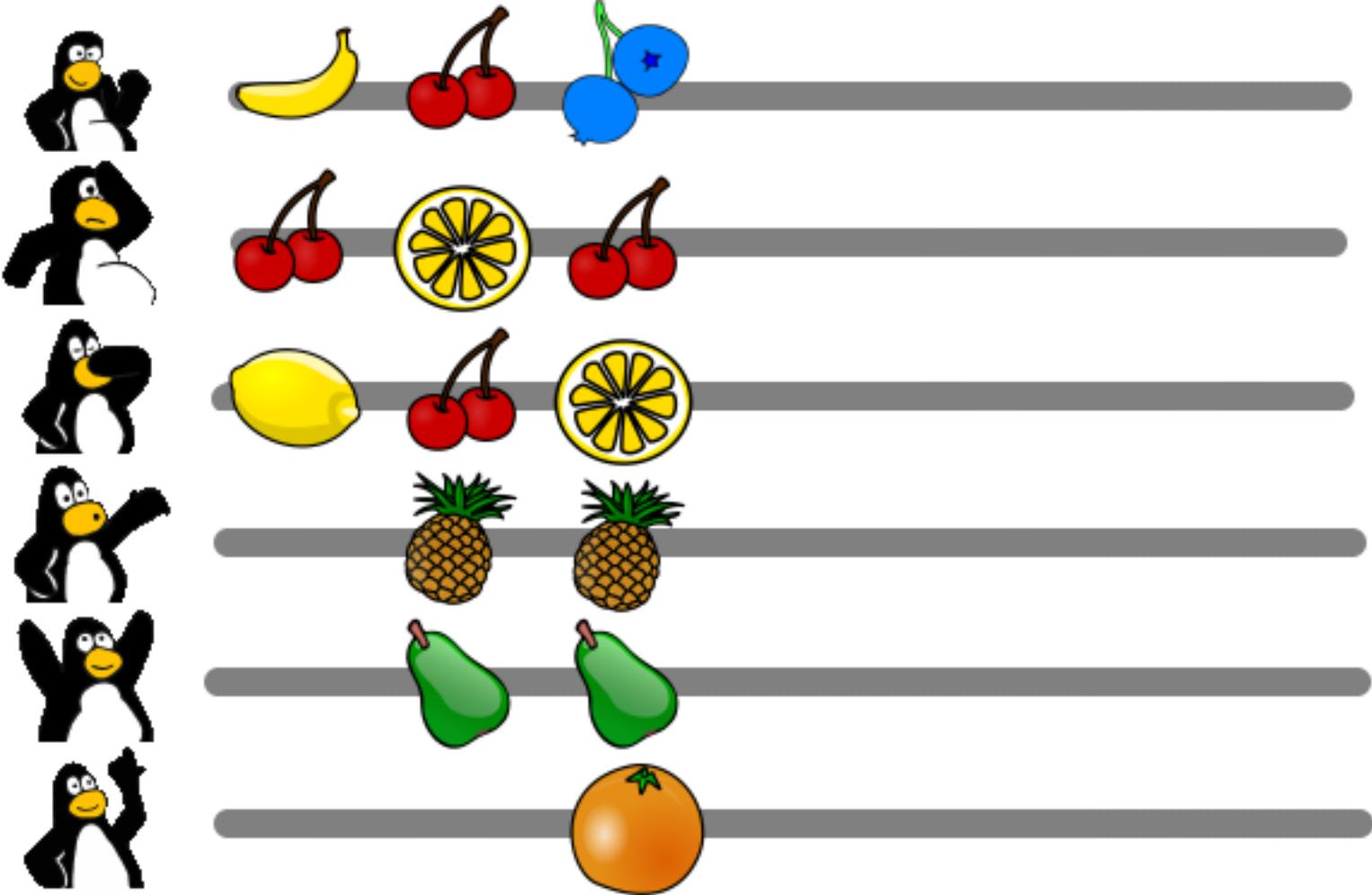
**Devs change software incrementally.
They commit revisions to the project.**



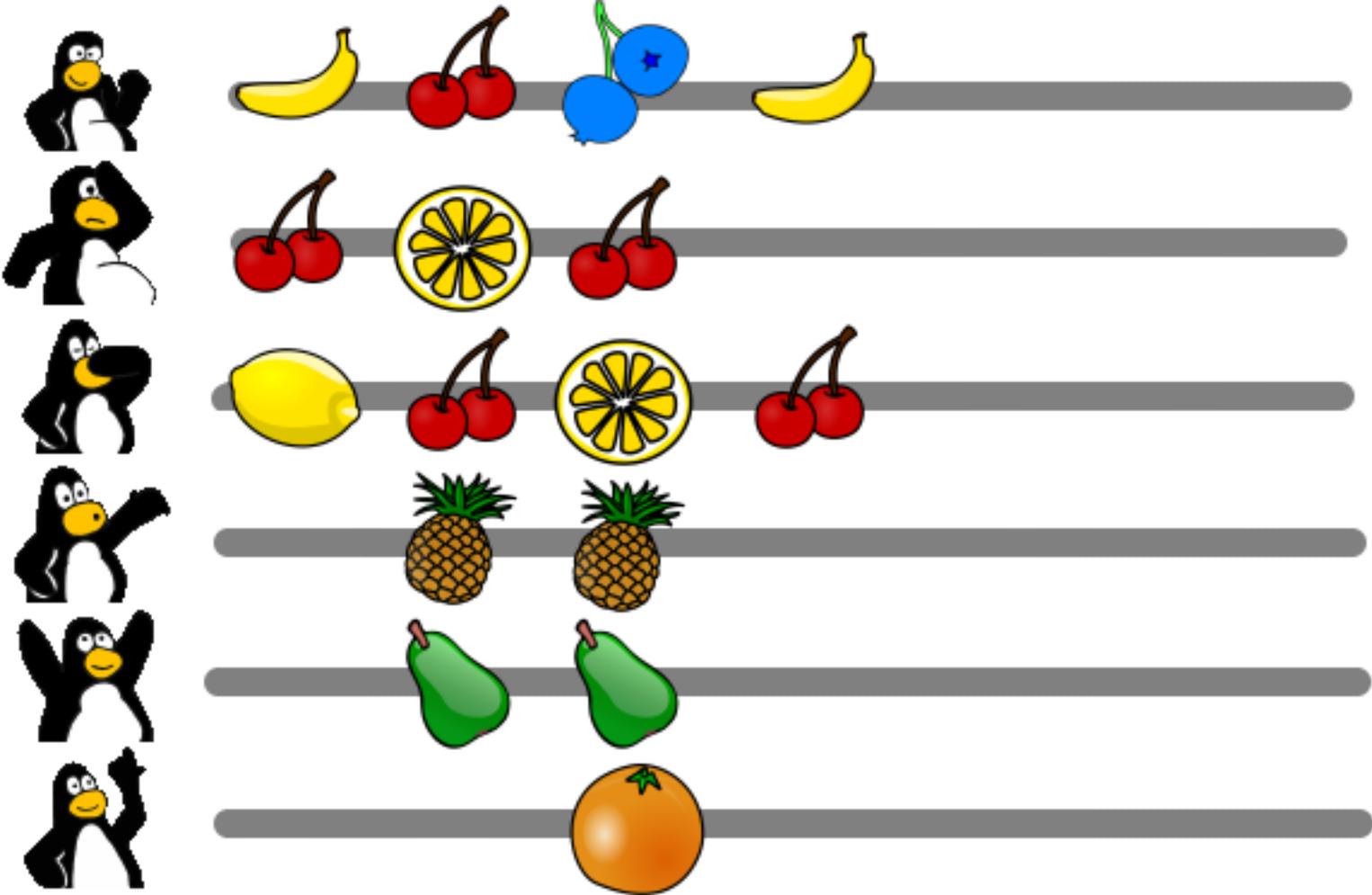
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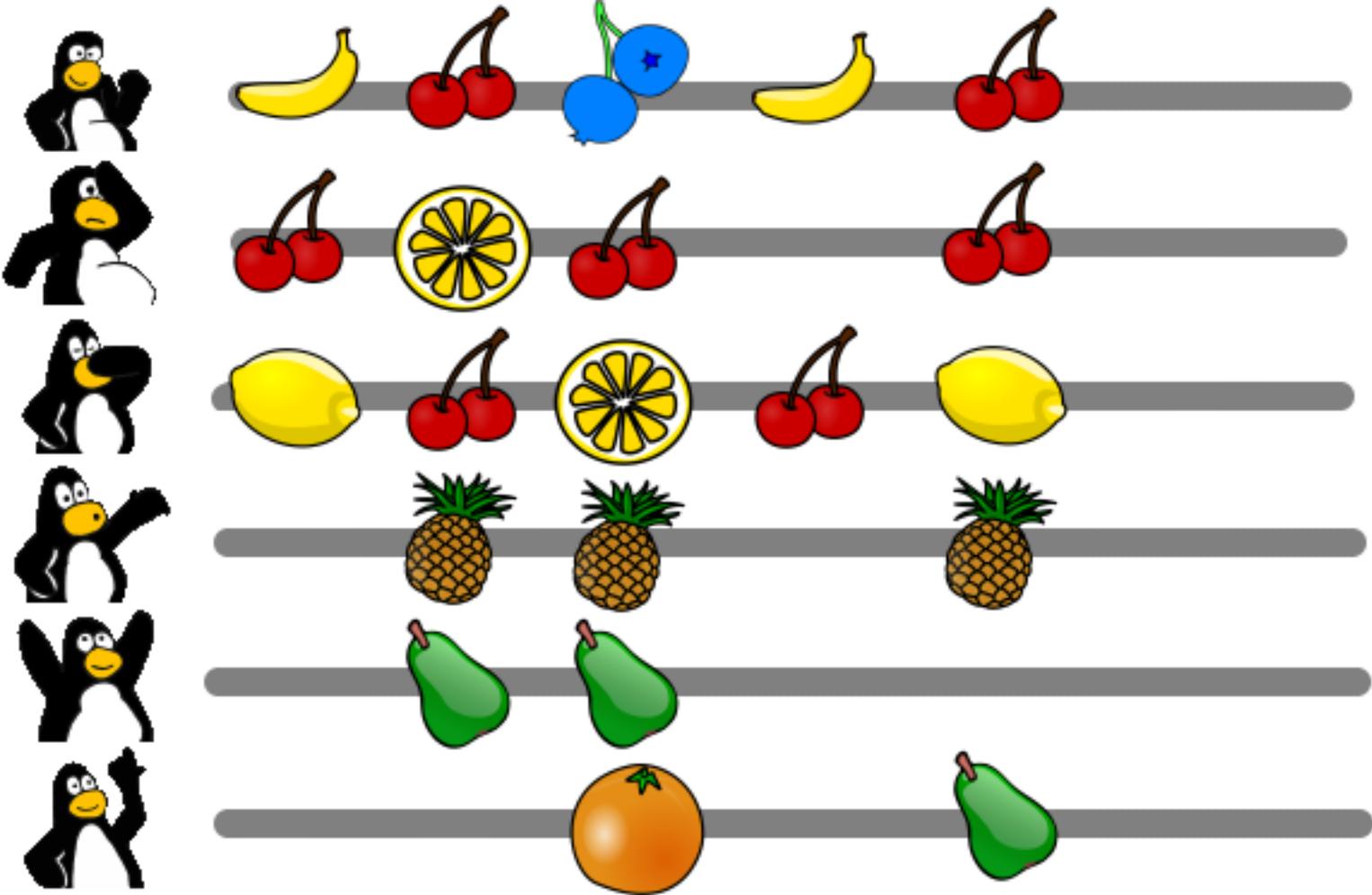
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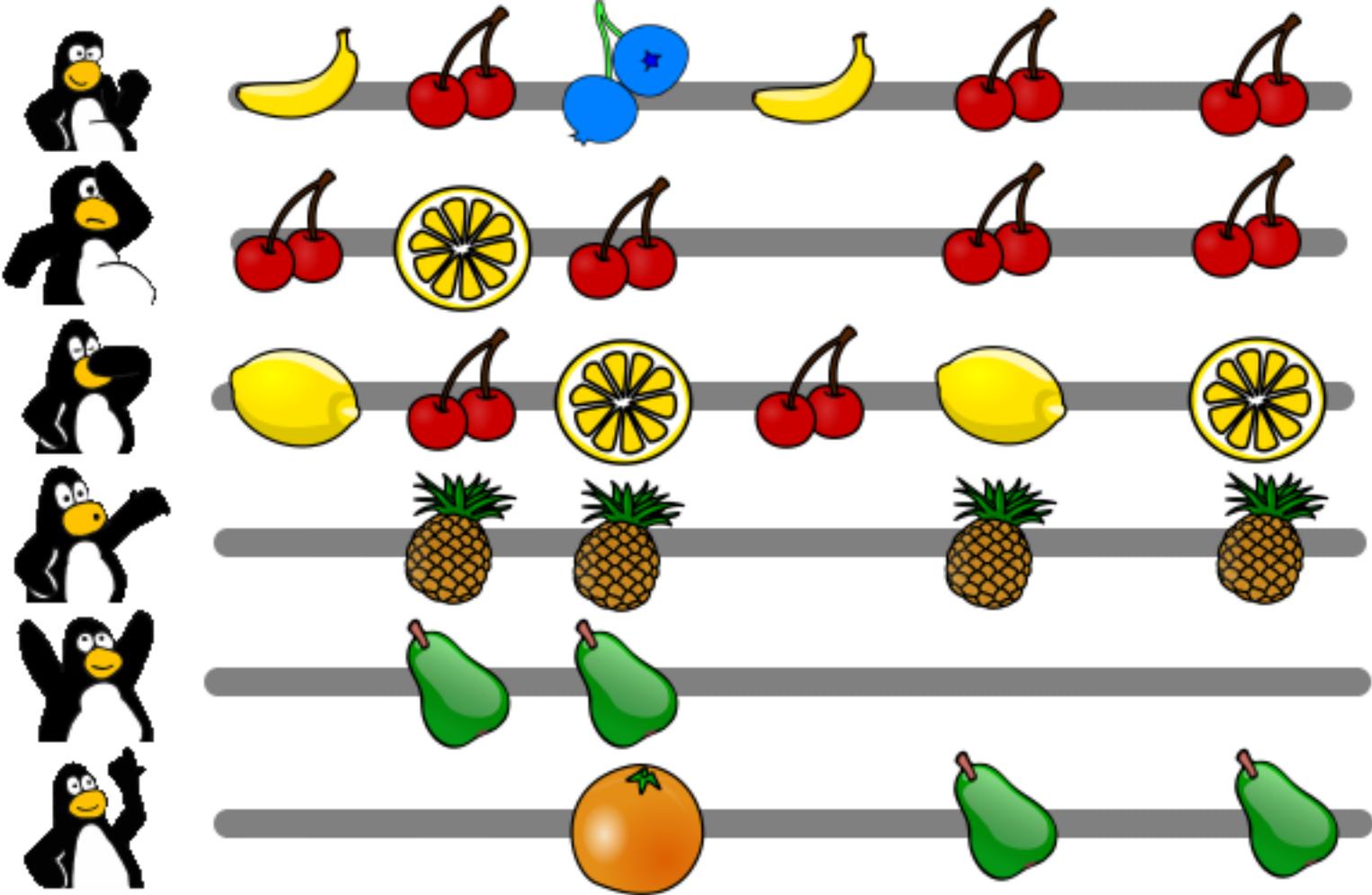
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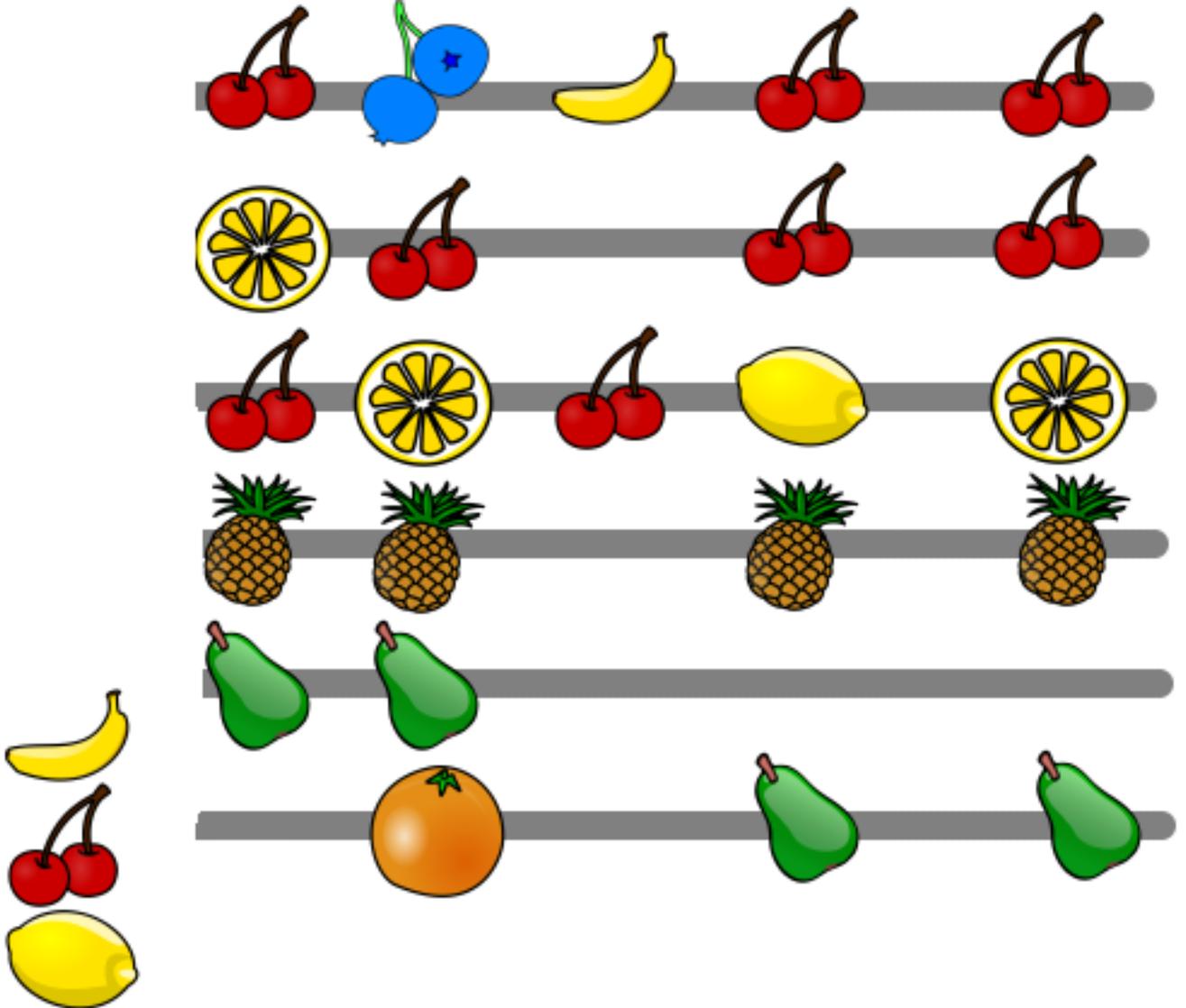


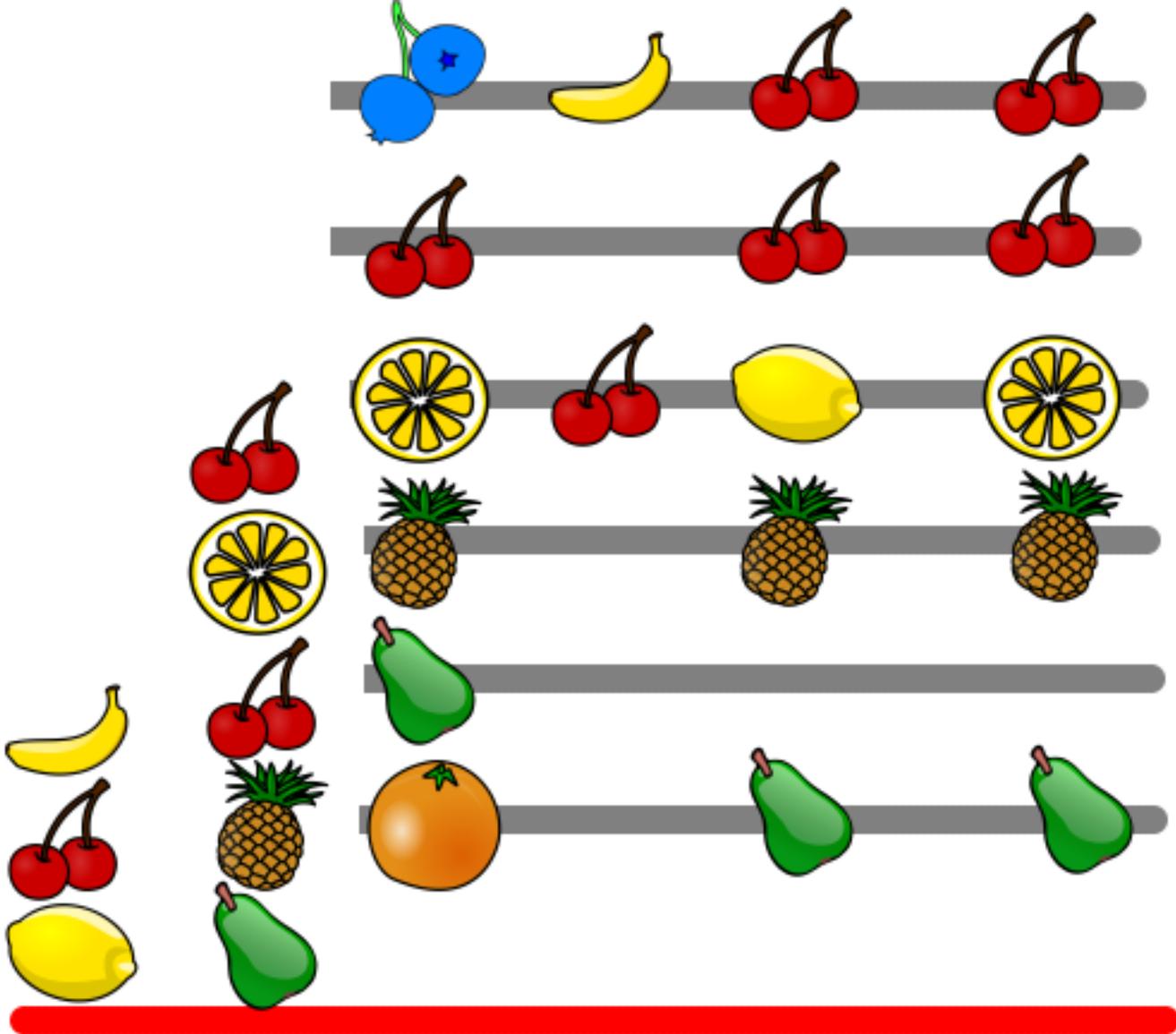
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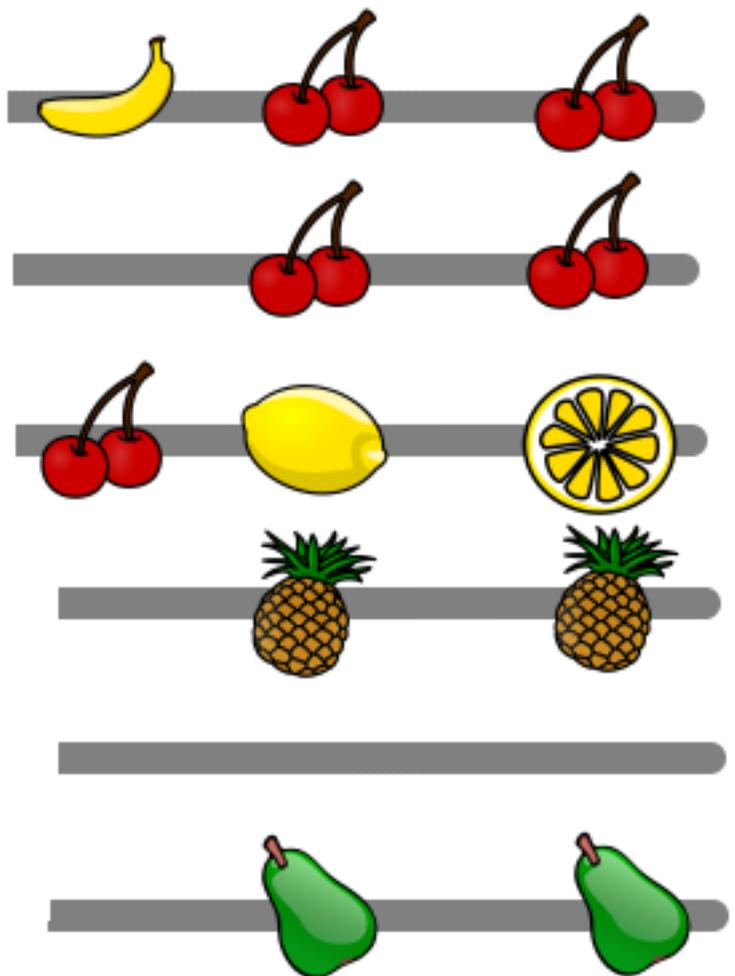
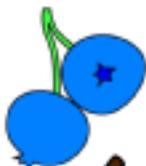
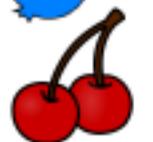
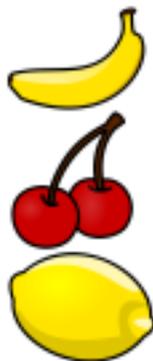


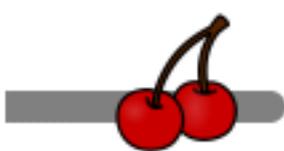
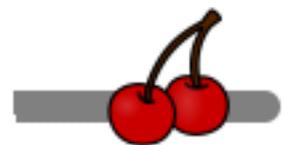
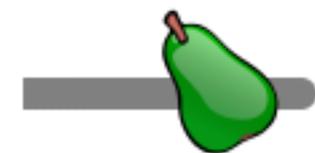
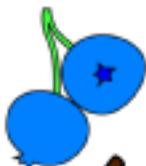
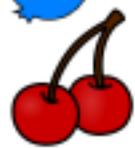
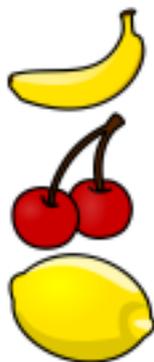
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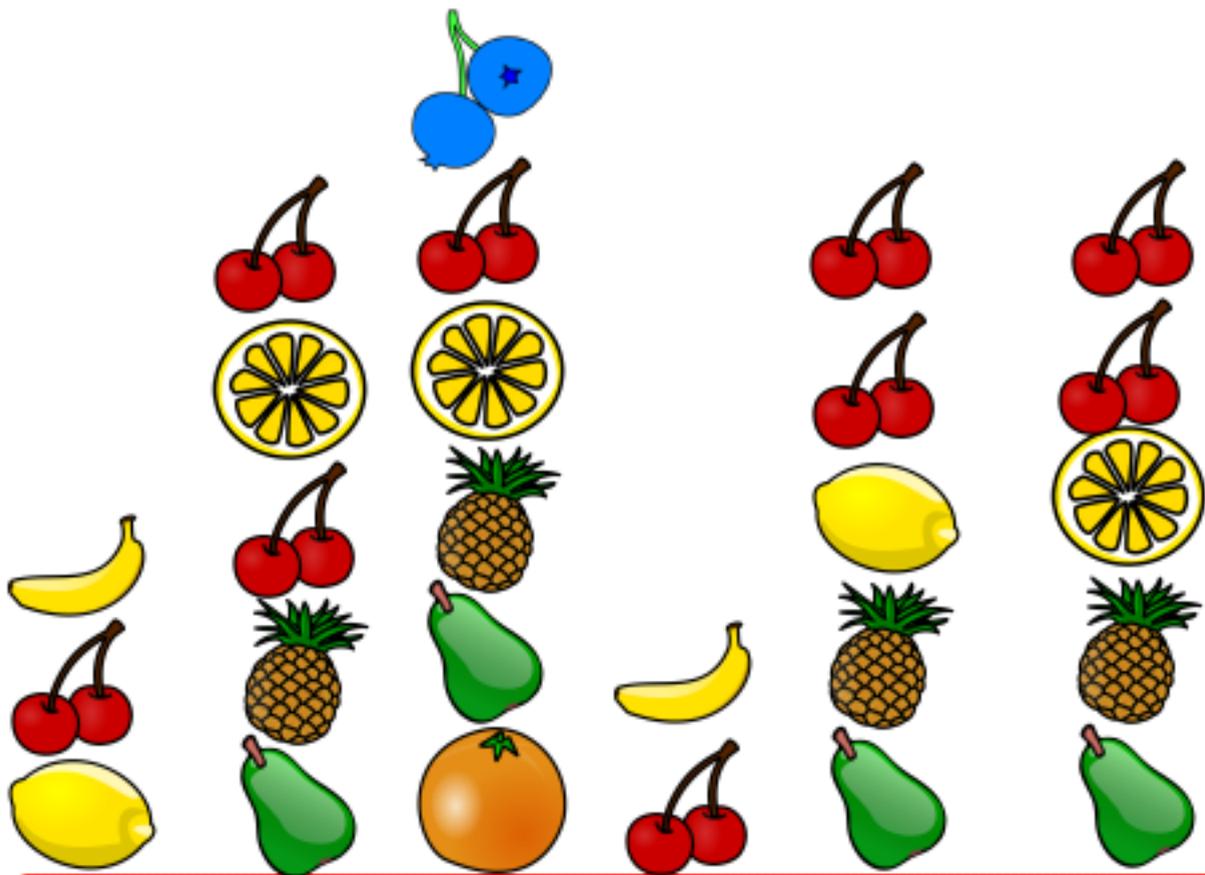




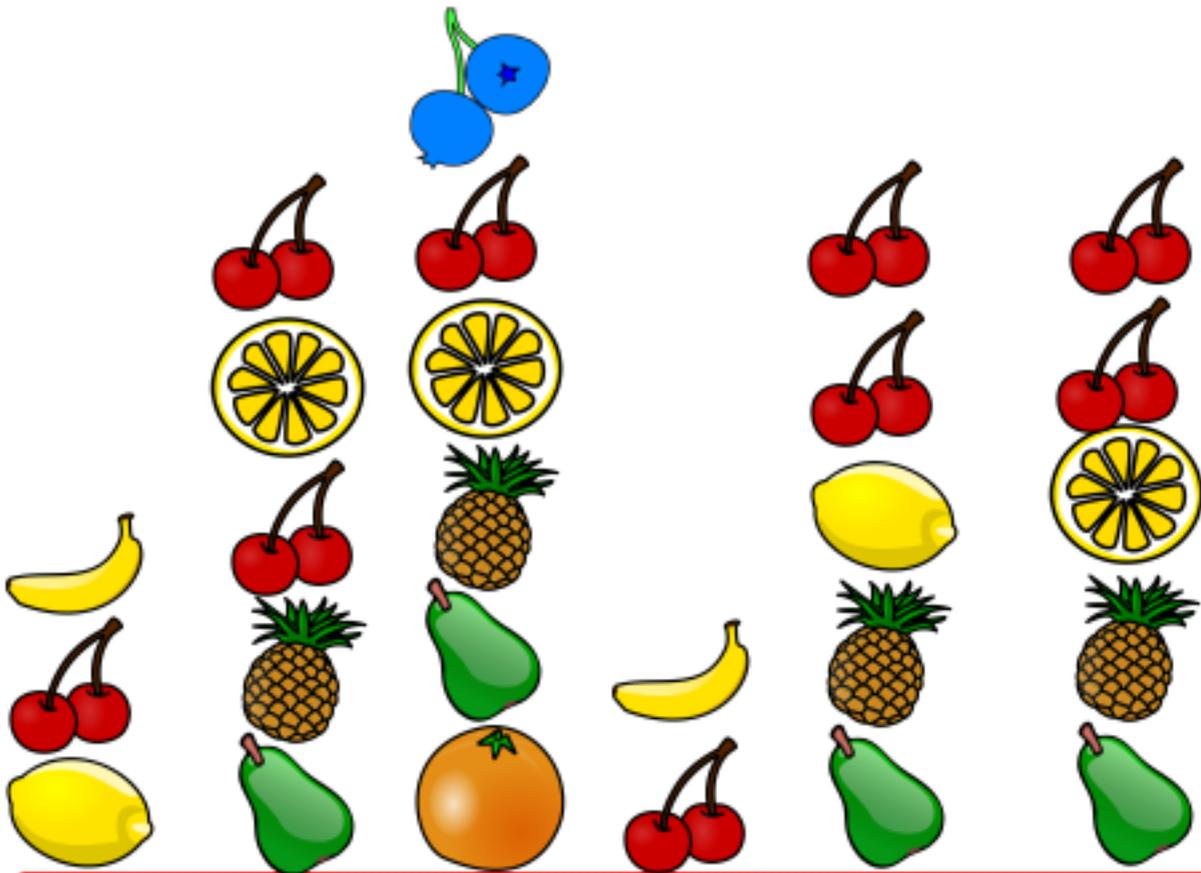




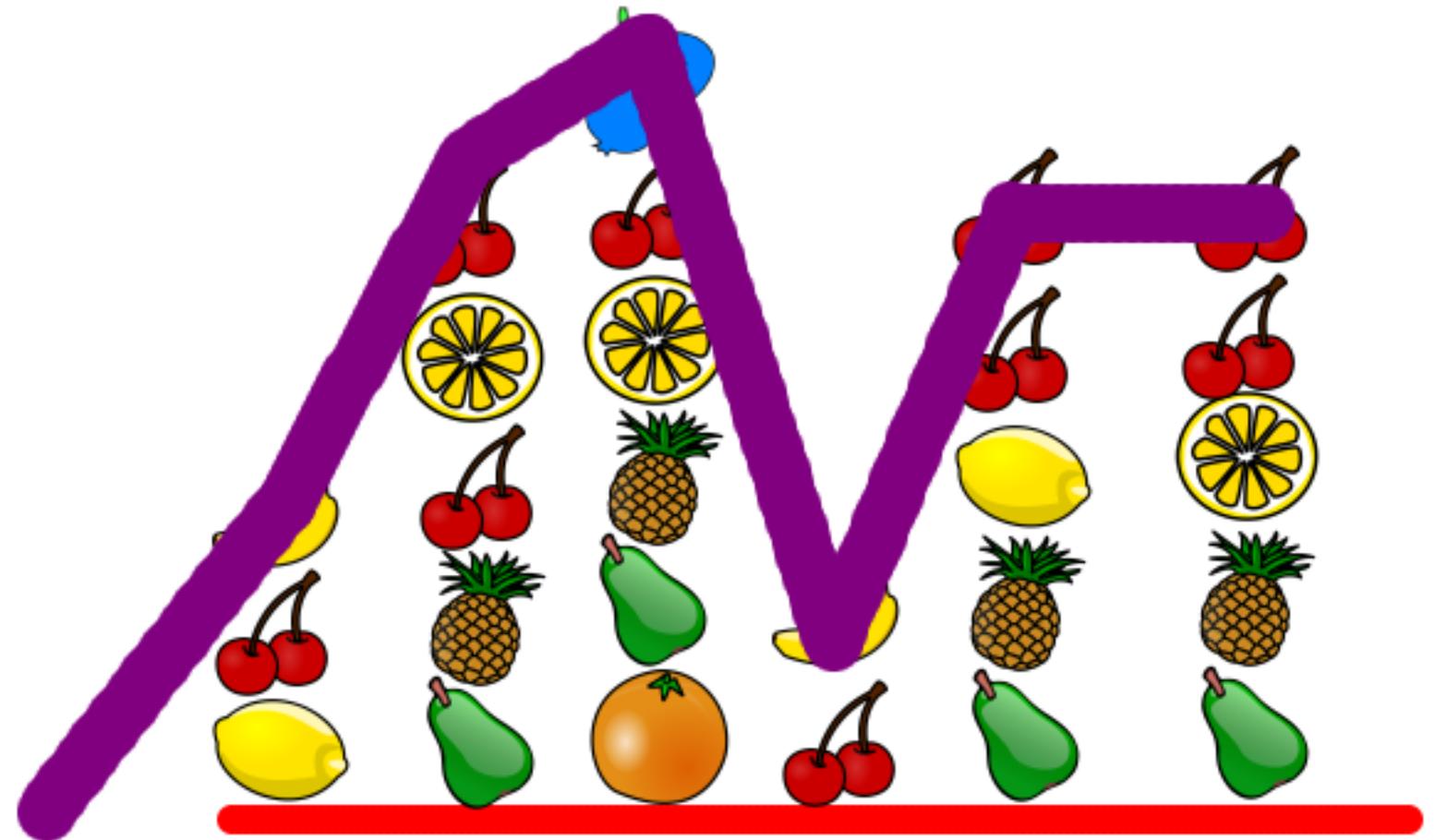




Aggregation



Aggregation





**revision
count**



time



revision
count

Timeseries

time





Discrete Events



Signal





Day



Week



Month



Year



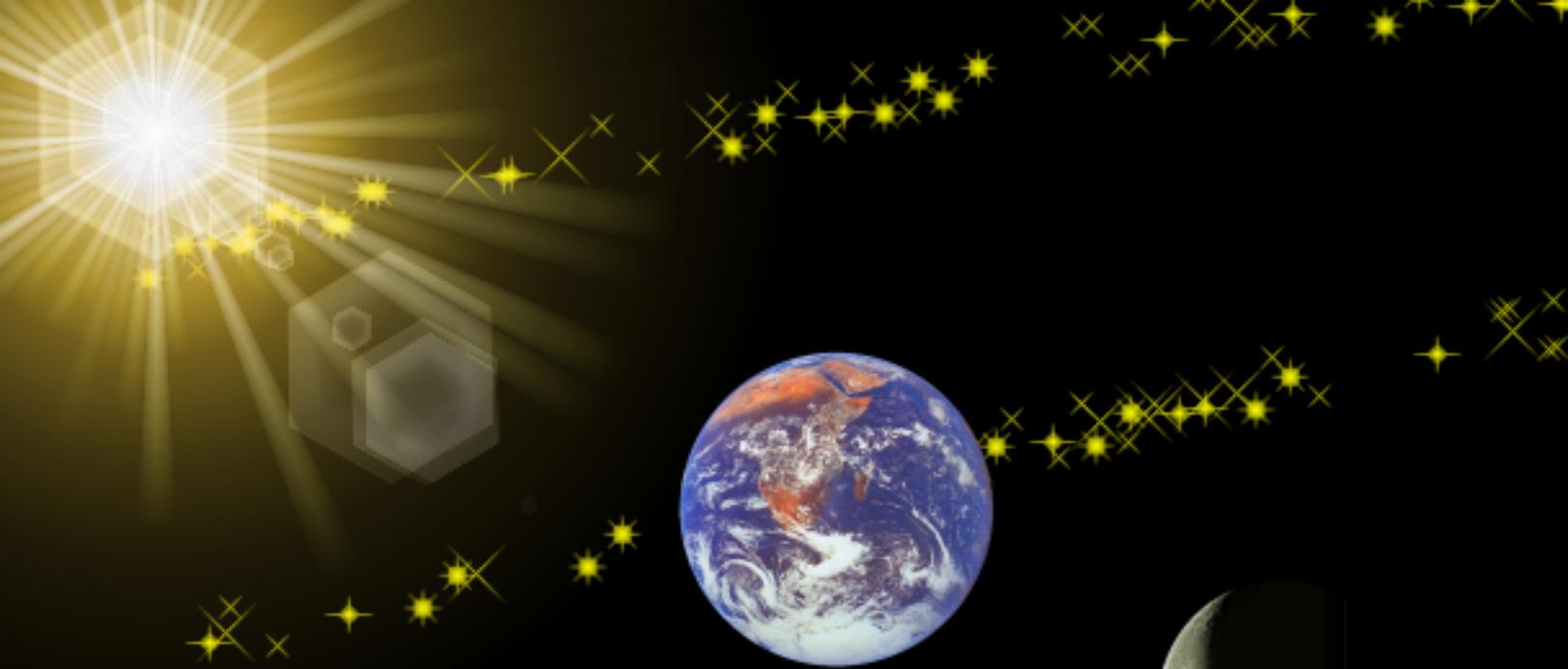
Day

Week

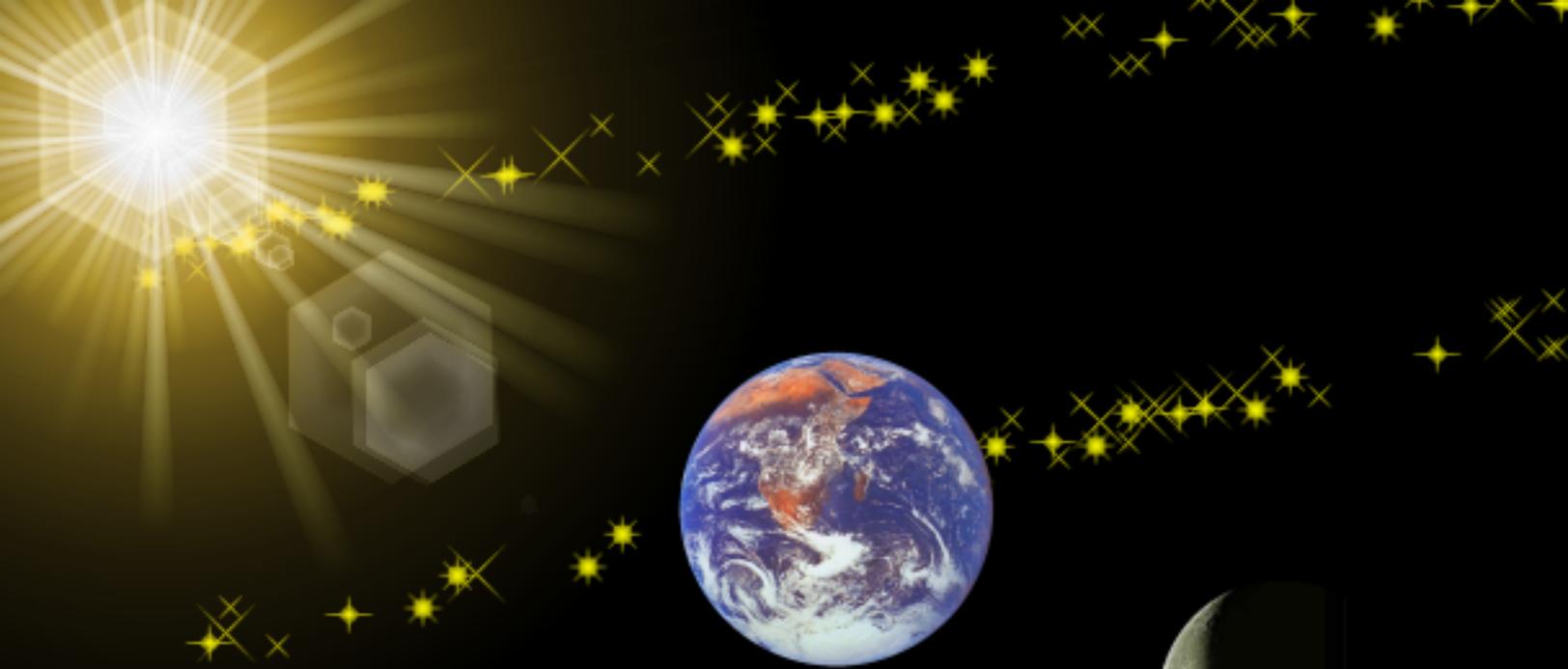
Month

Intervals

Year



Does software
follow earth
cycles, or its own?



Maybe instead
of assuming
we should go ahead..



we should go ahead
and
100k

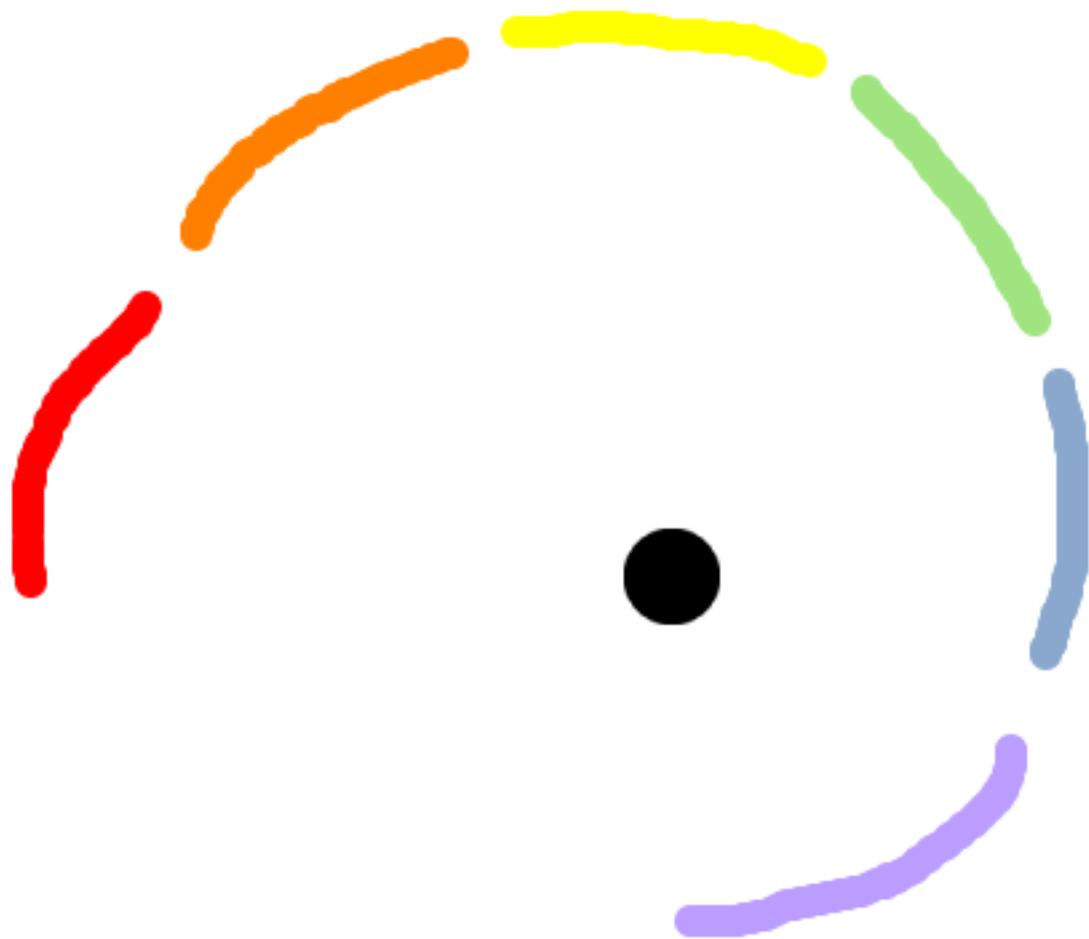


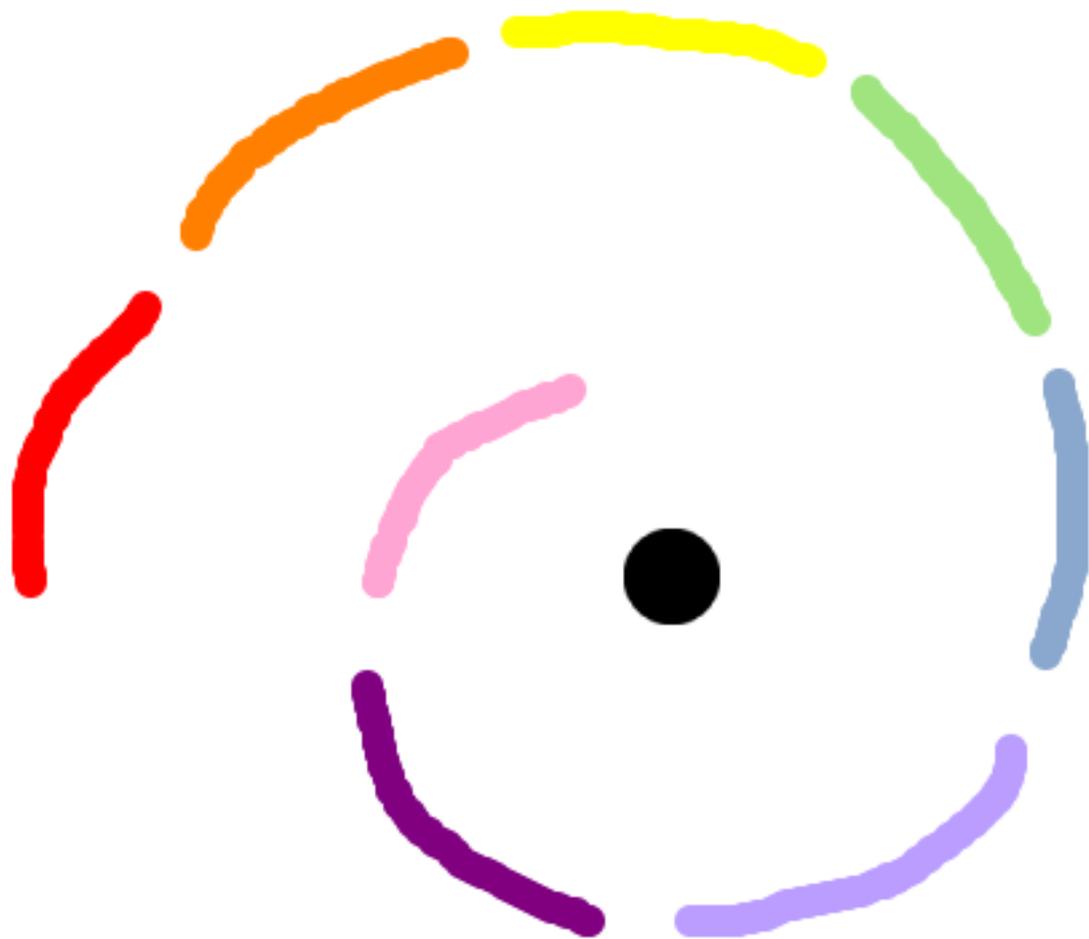
Recurrent
Behaviour











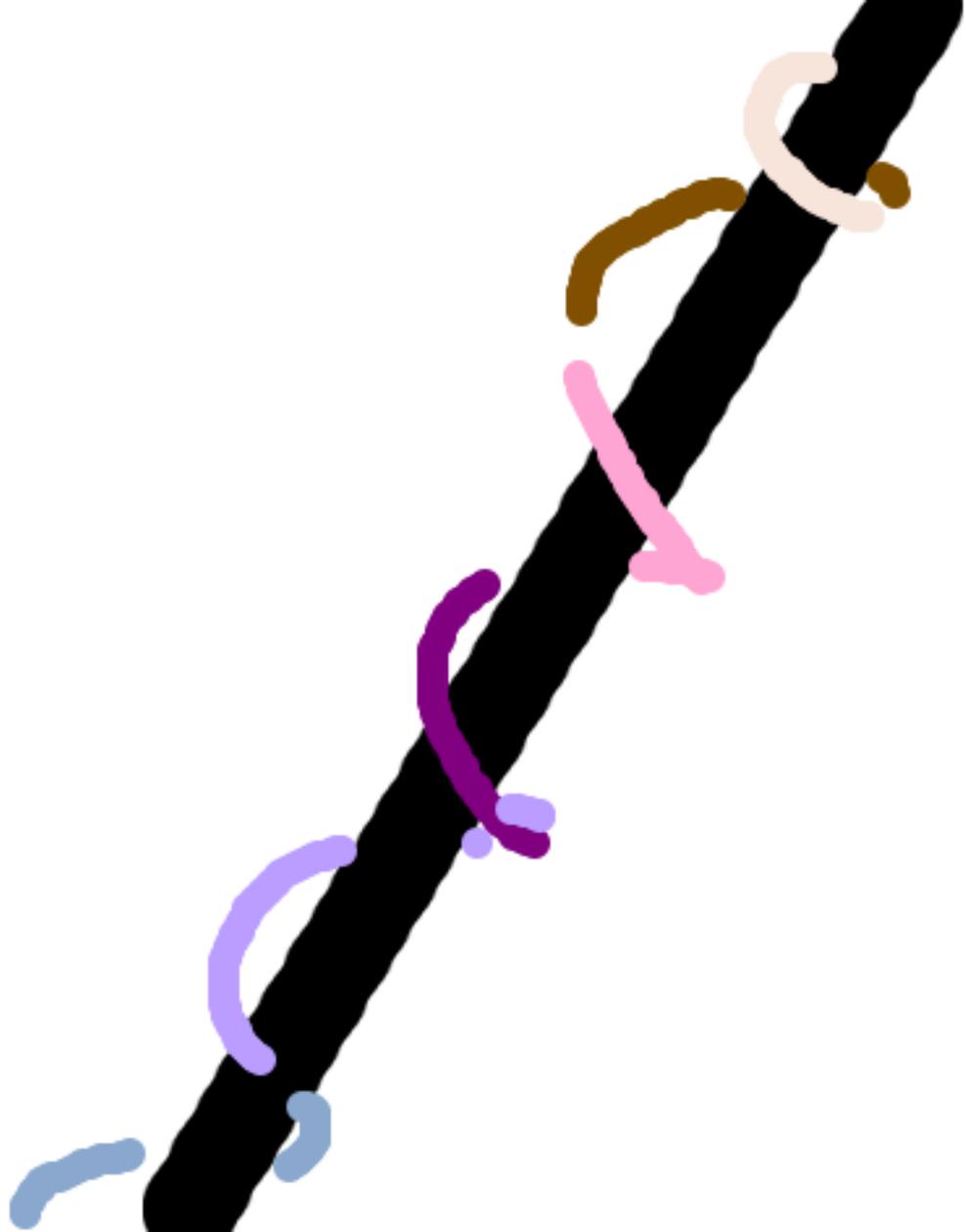


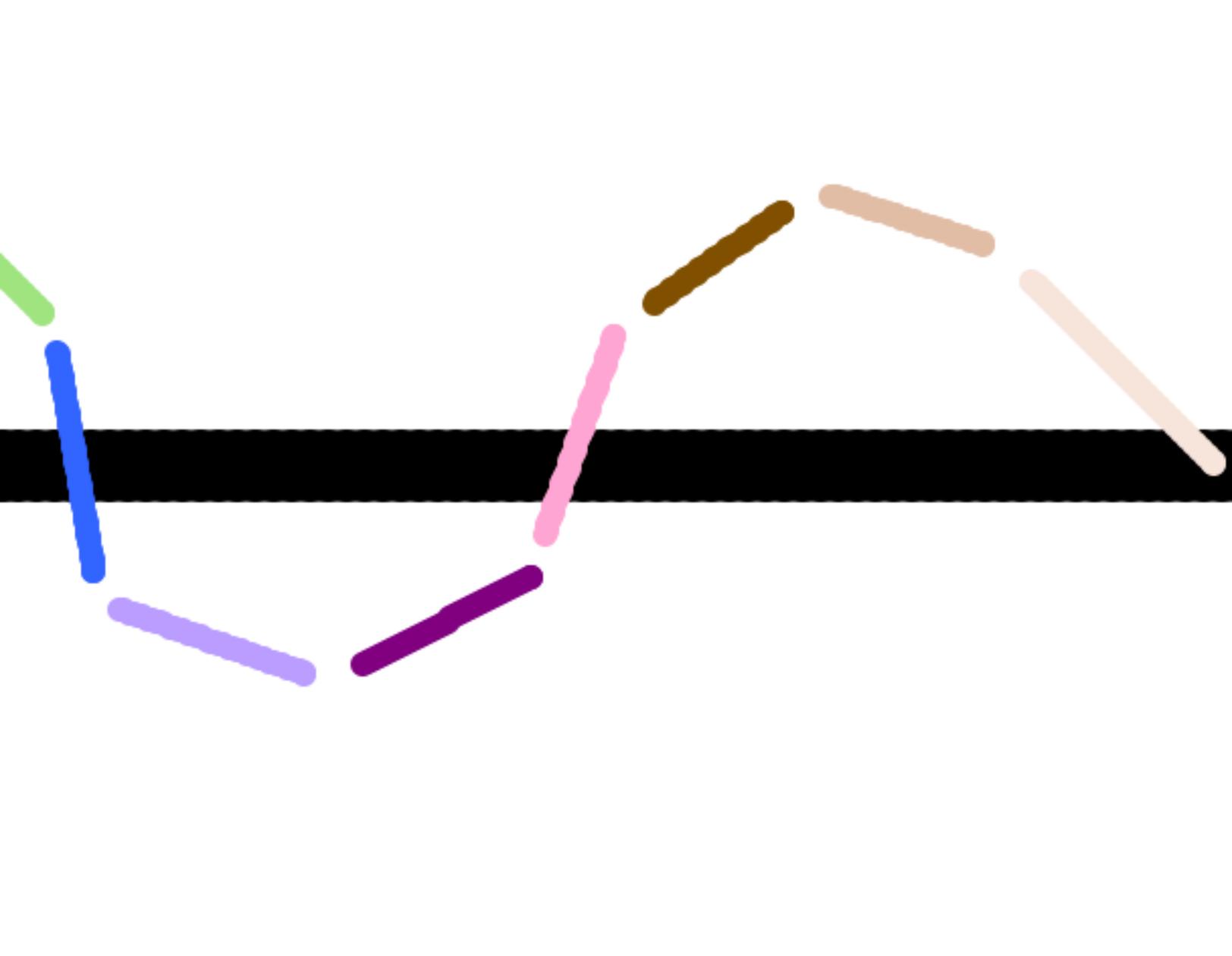


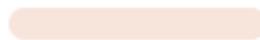
Iterative Development



Let us rotate this...







plan

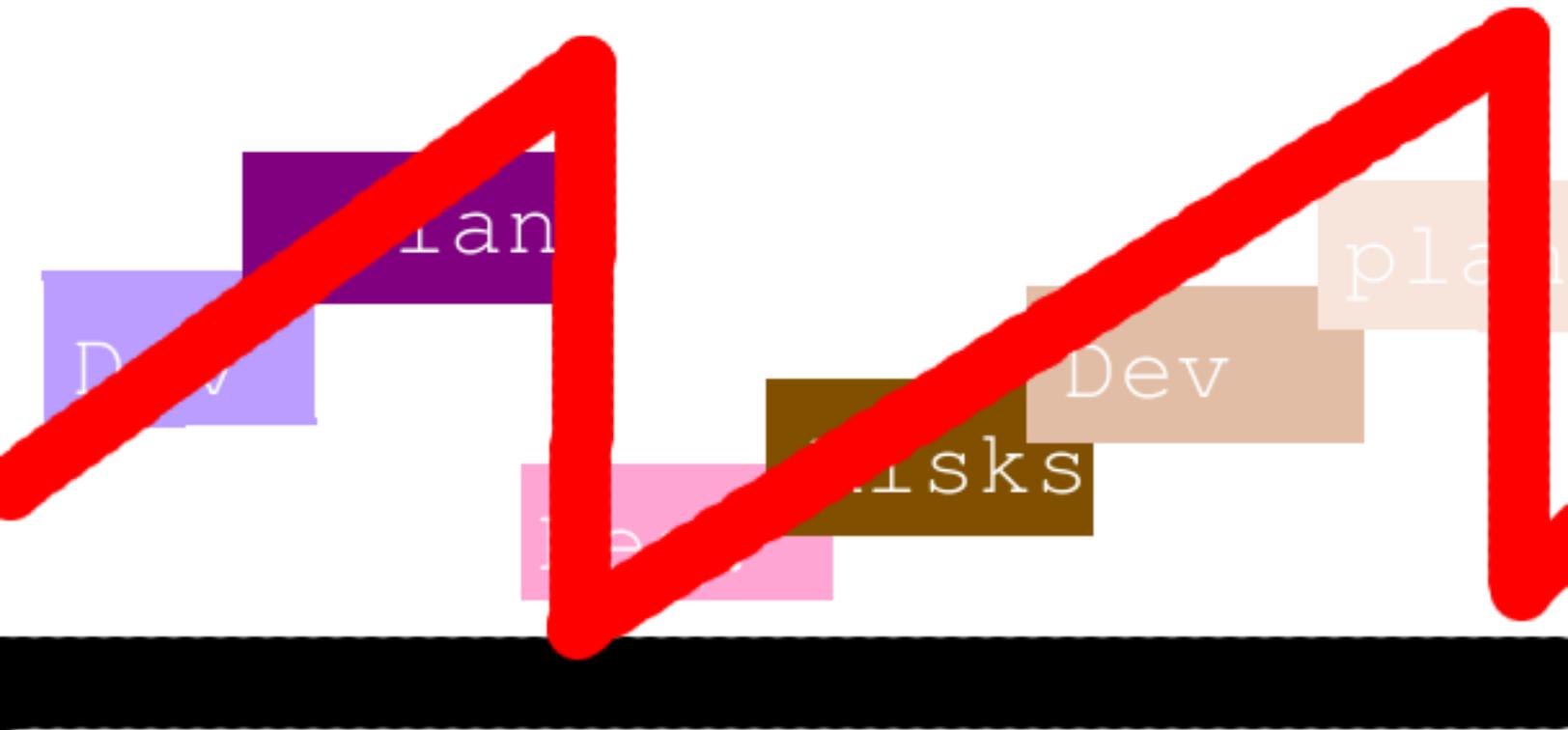
Dev

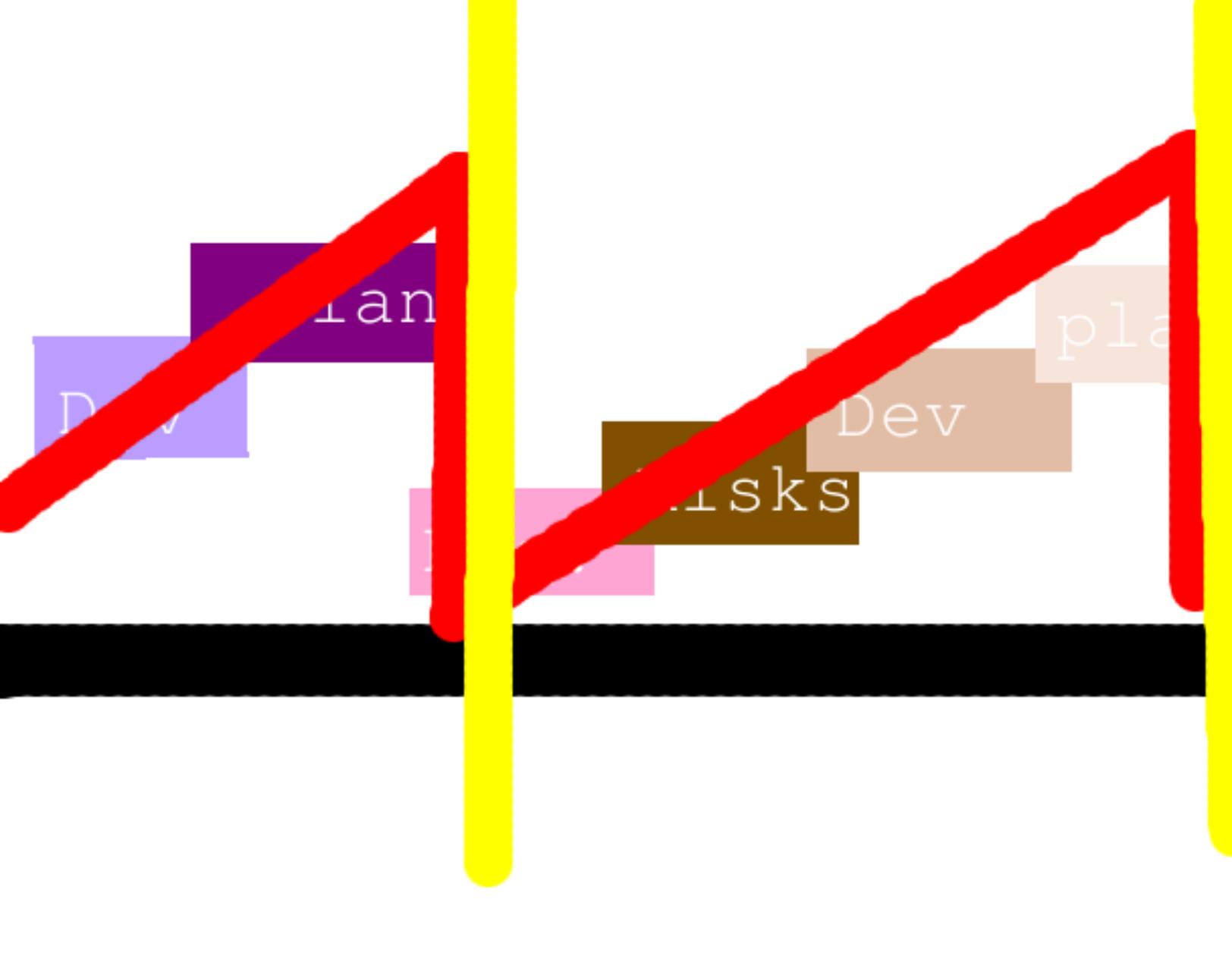
Req.

Risks

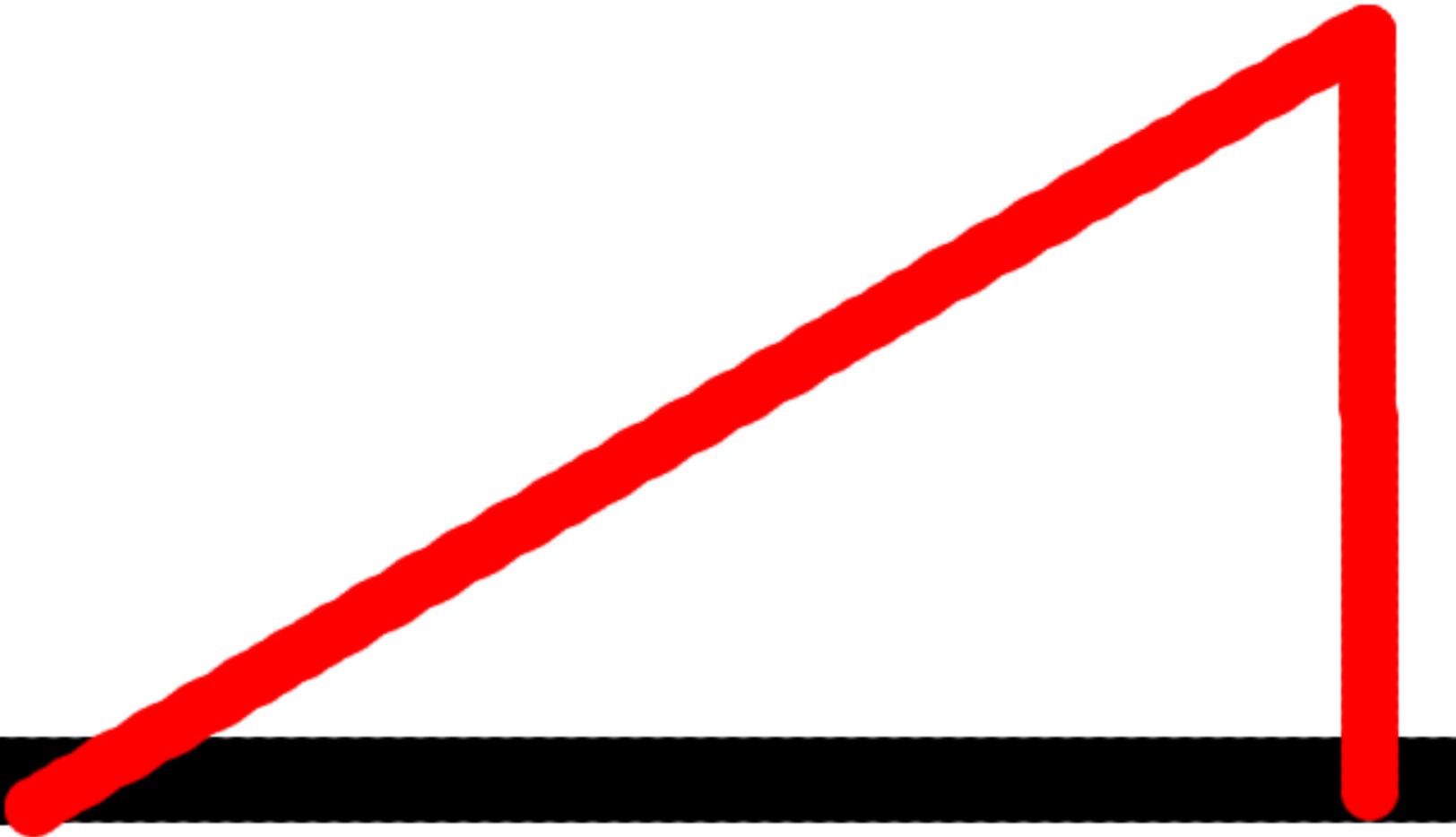
Dev

plan

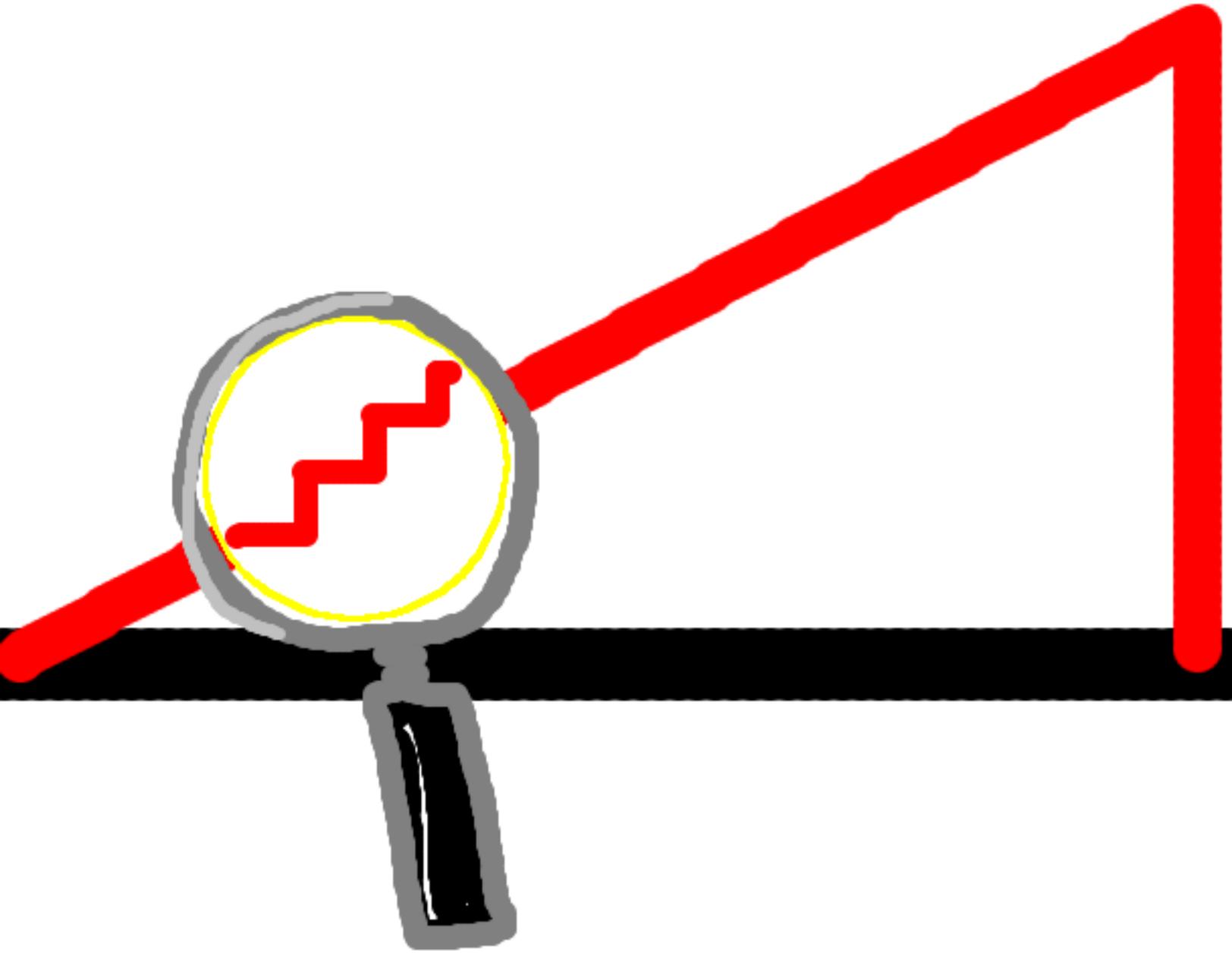




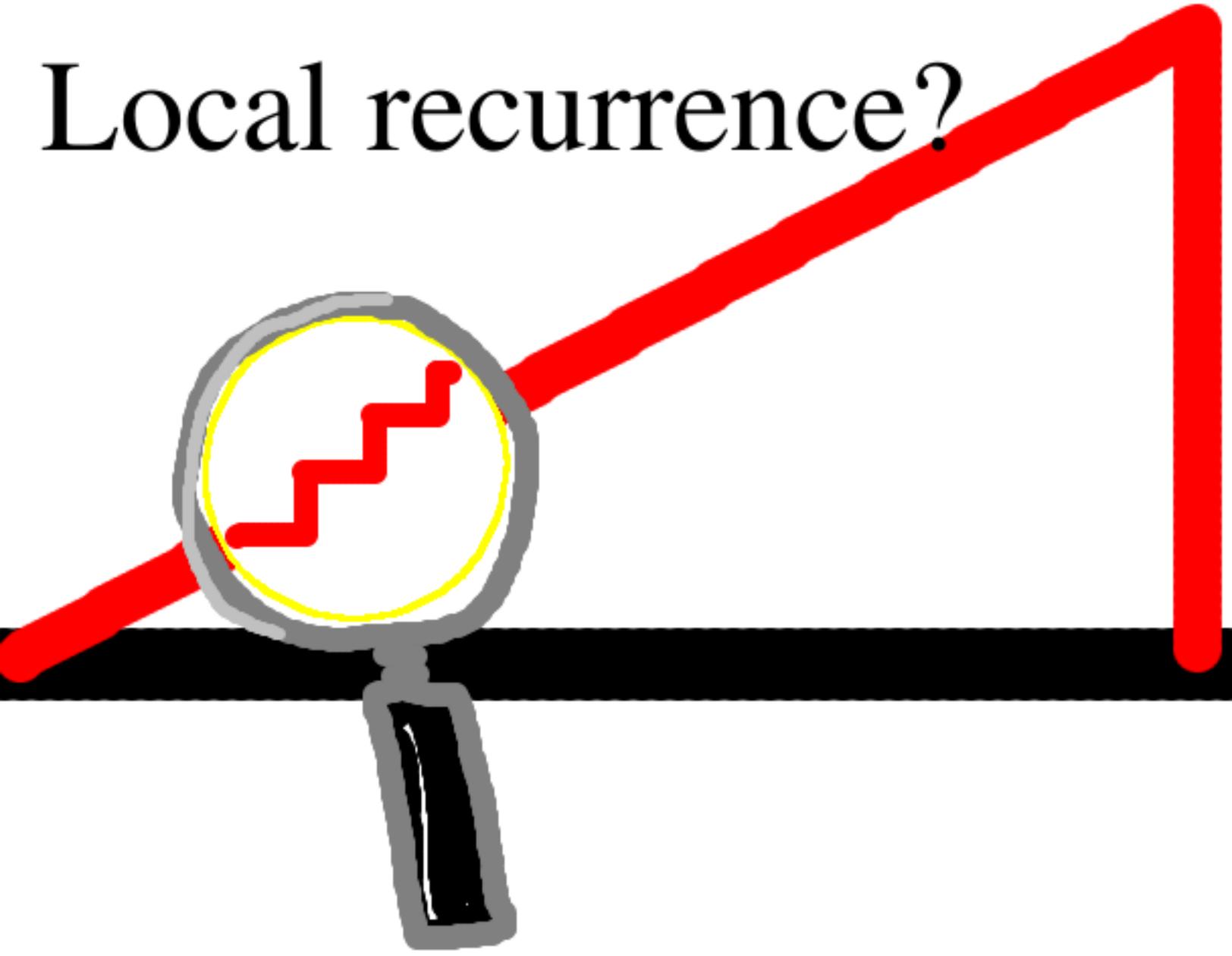


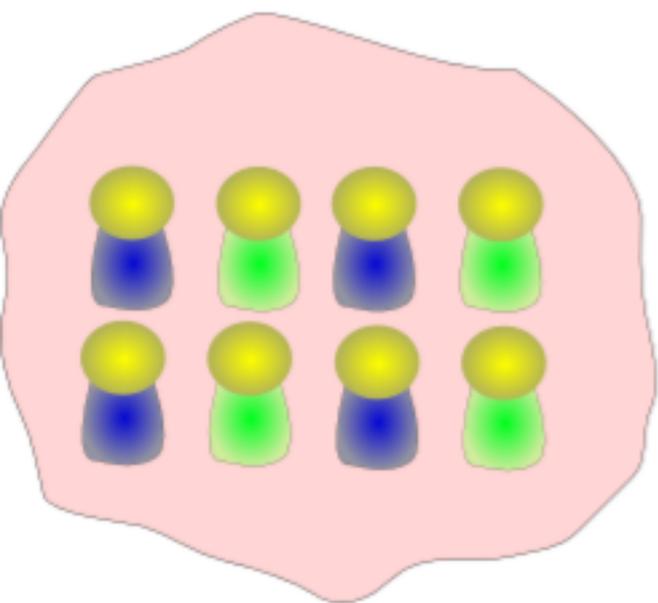


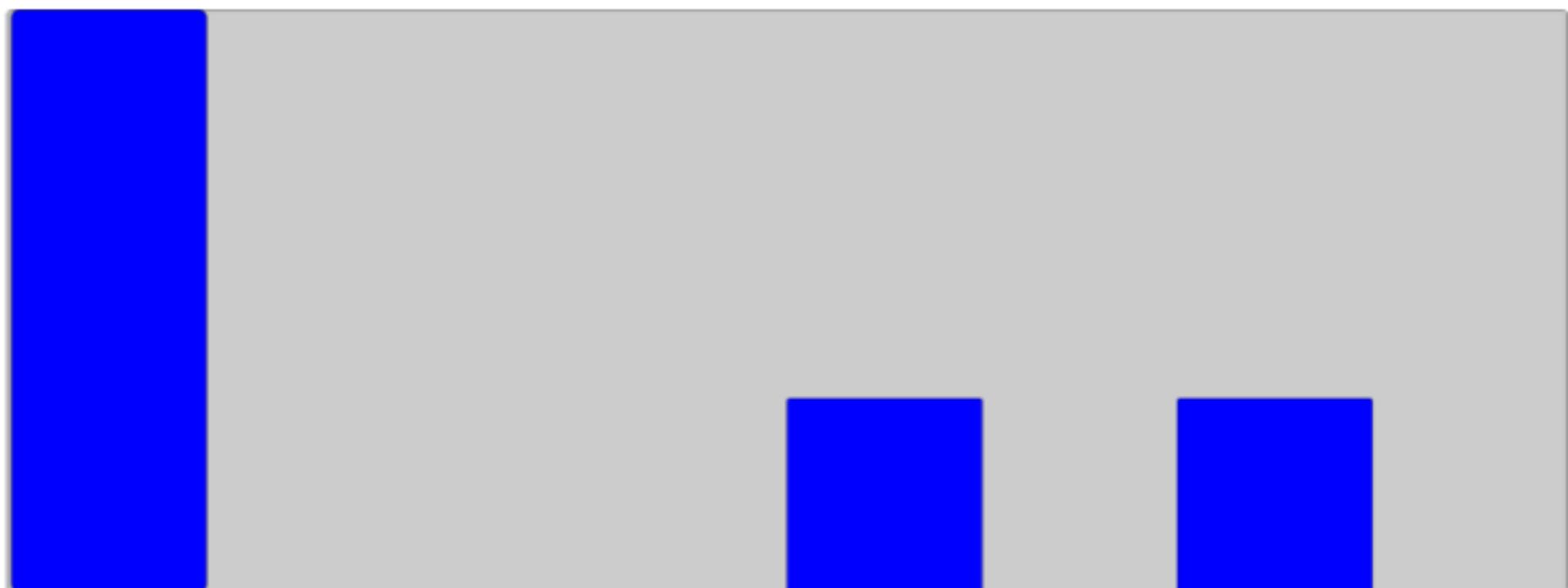
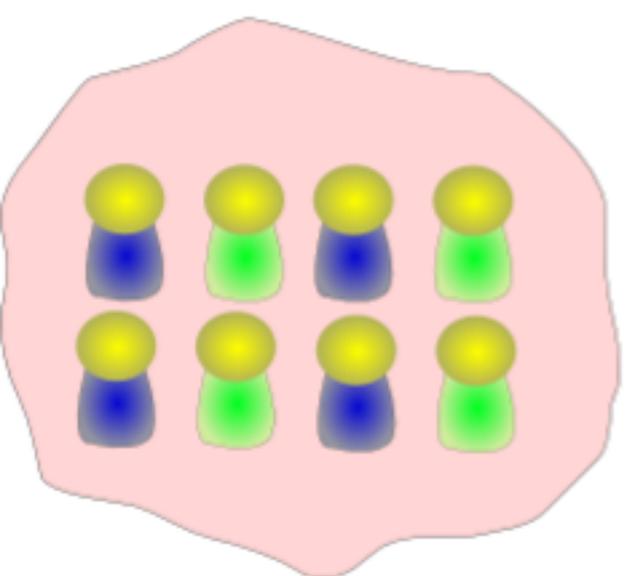
An iteration

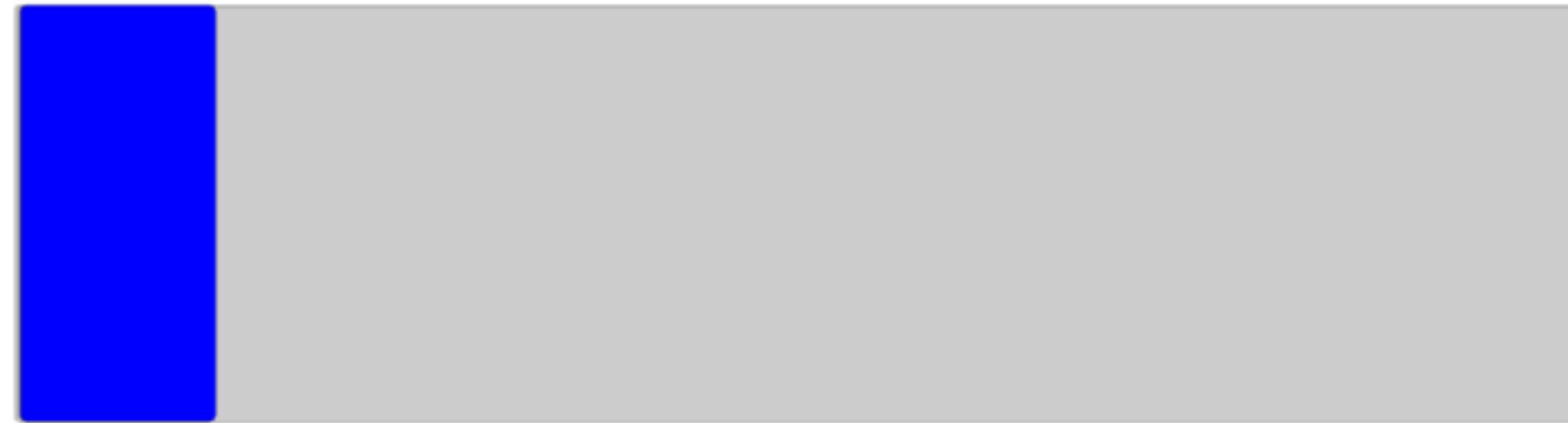
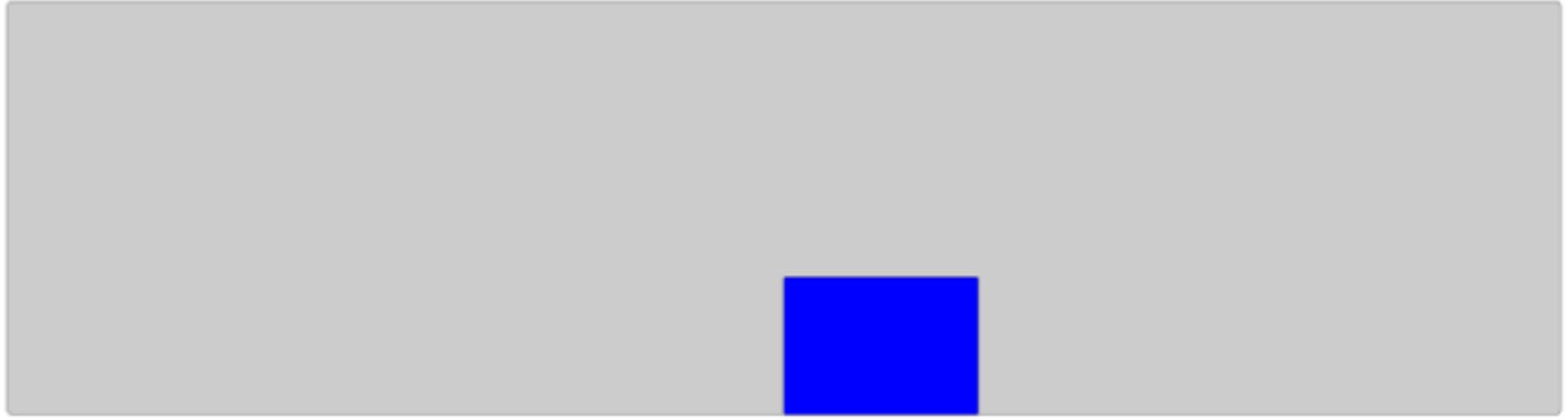
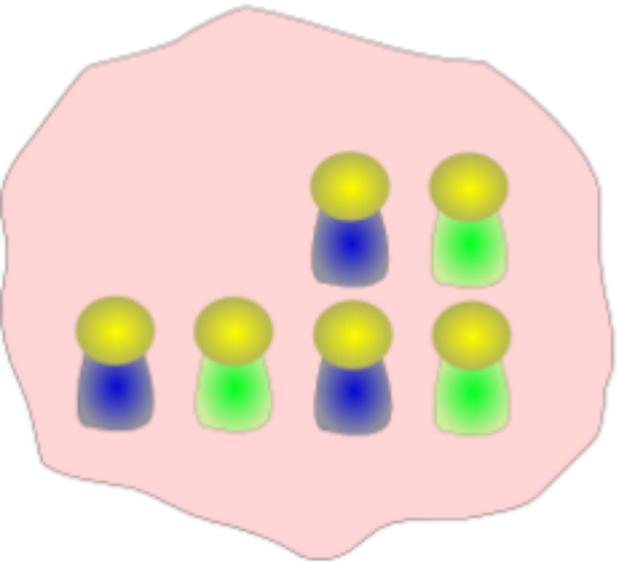
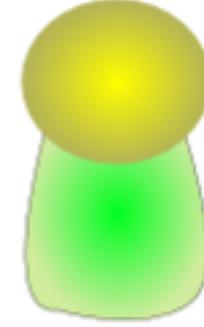
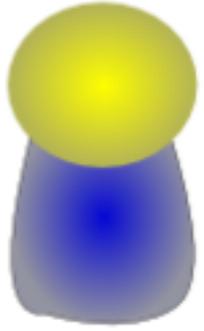


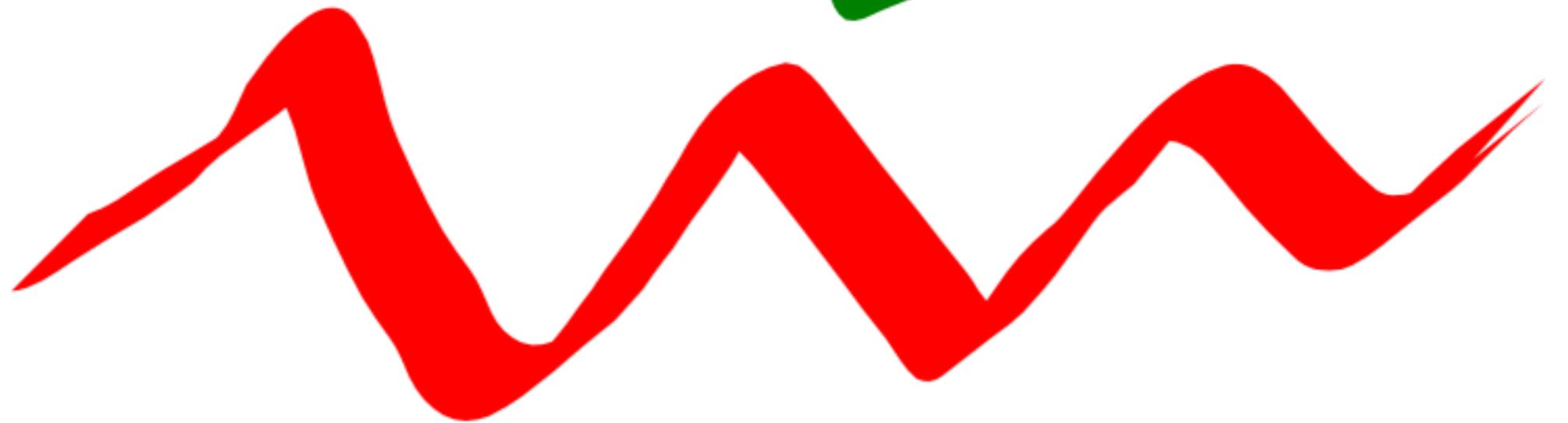
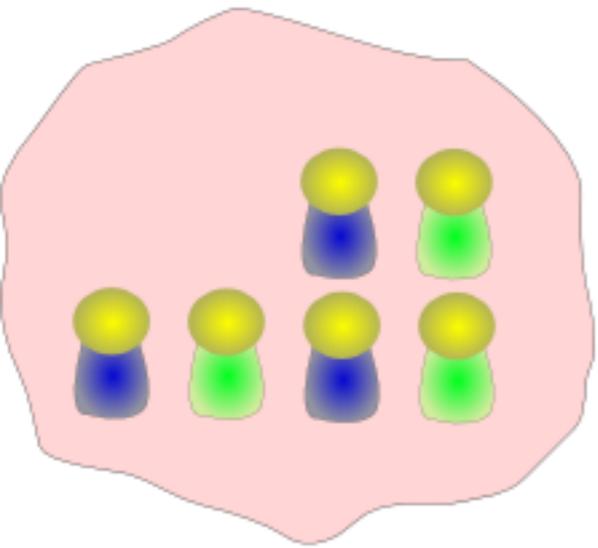
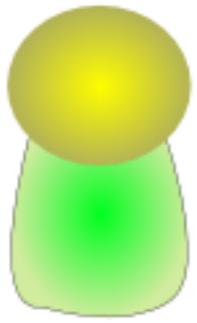
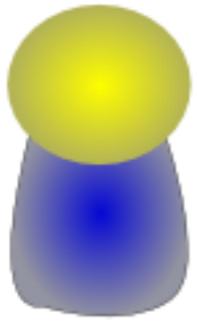
Local recurrence?









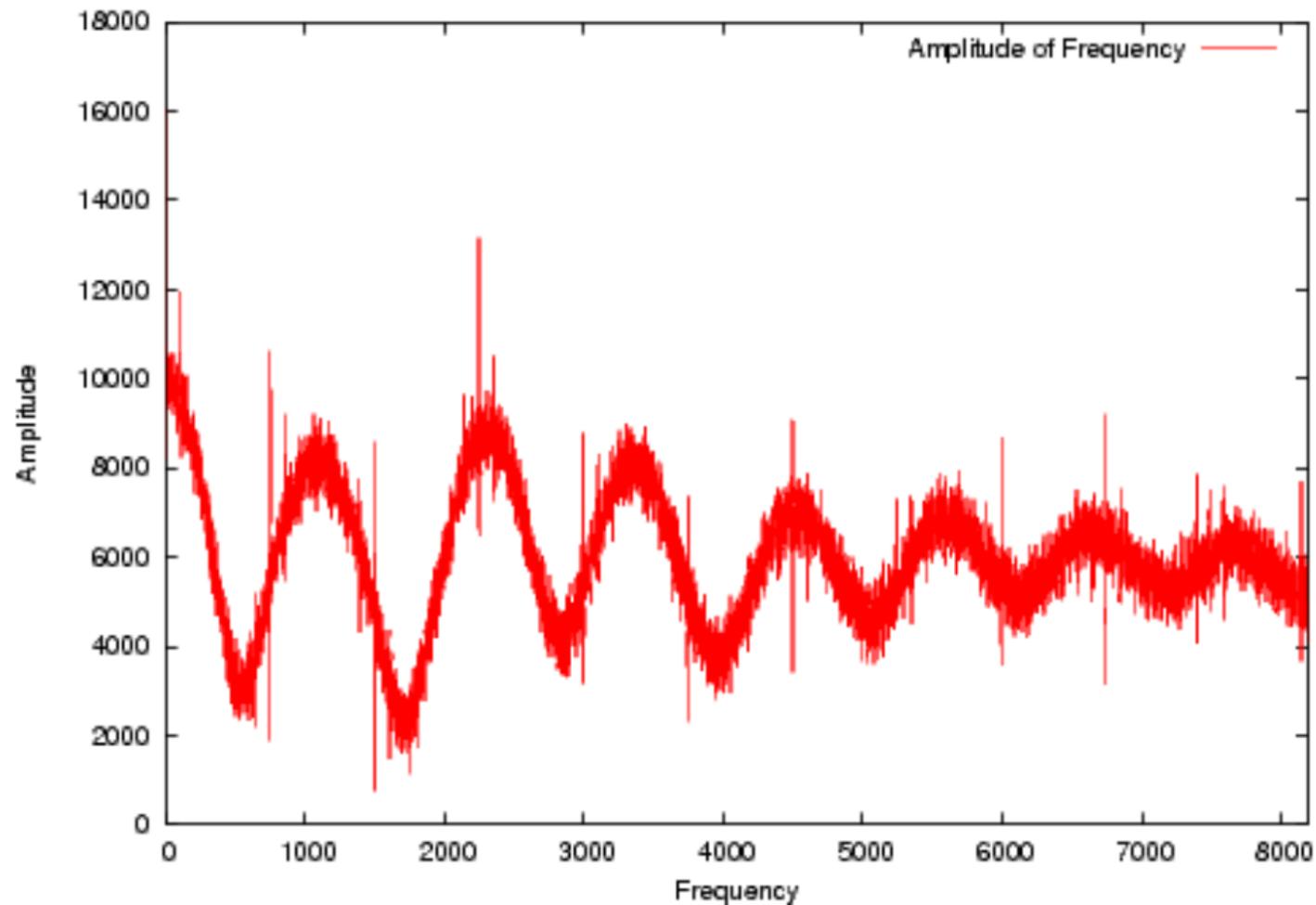


Fourier transform:

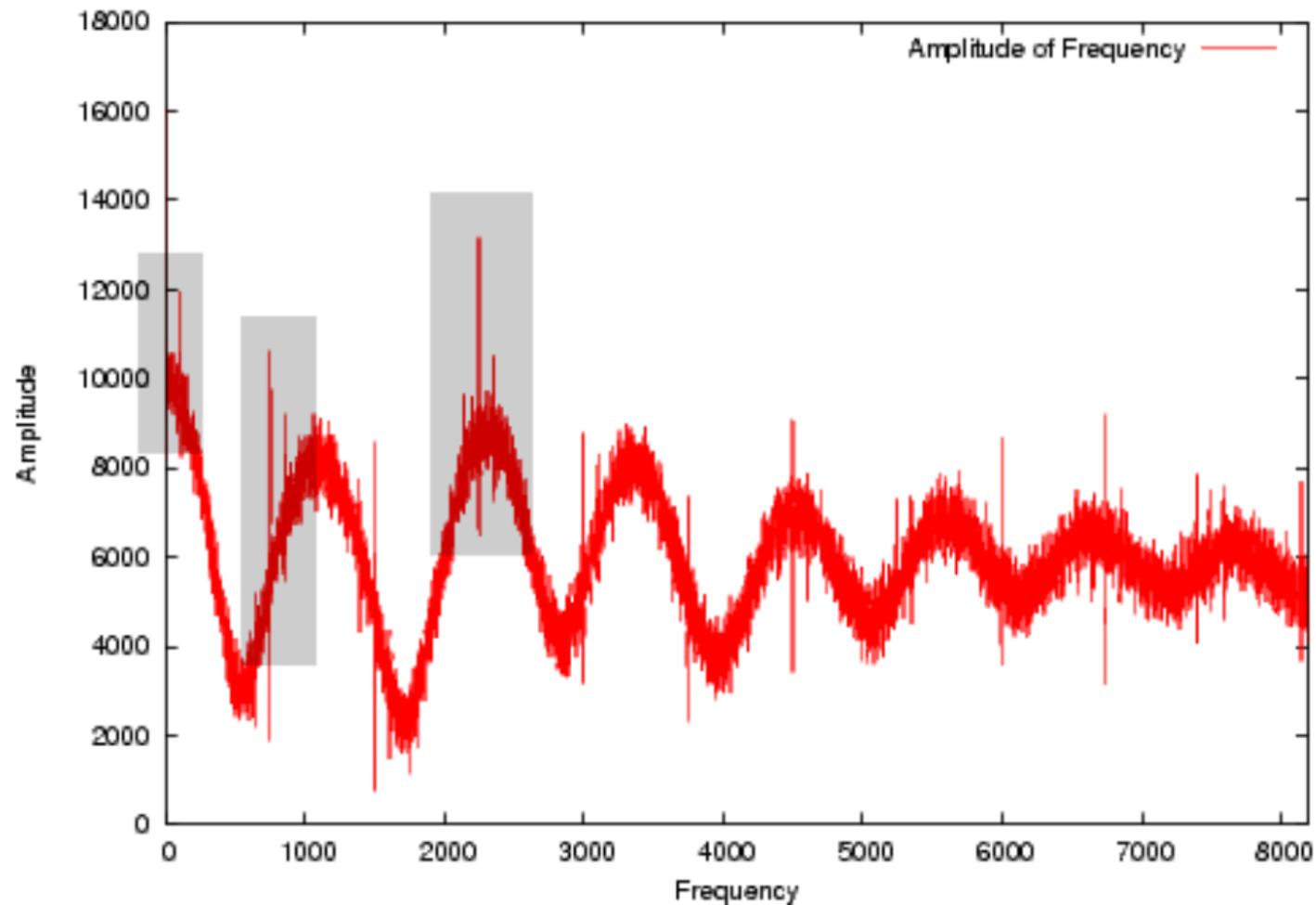
- * recurrent behaviour
- * periodicities

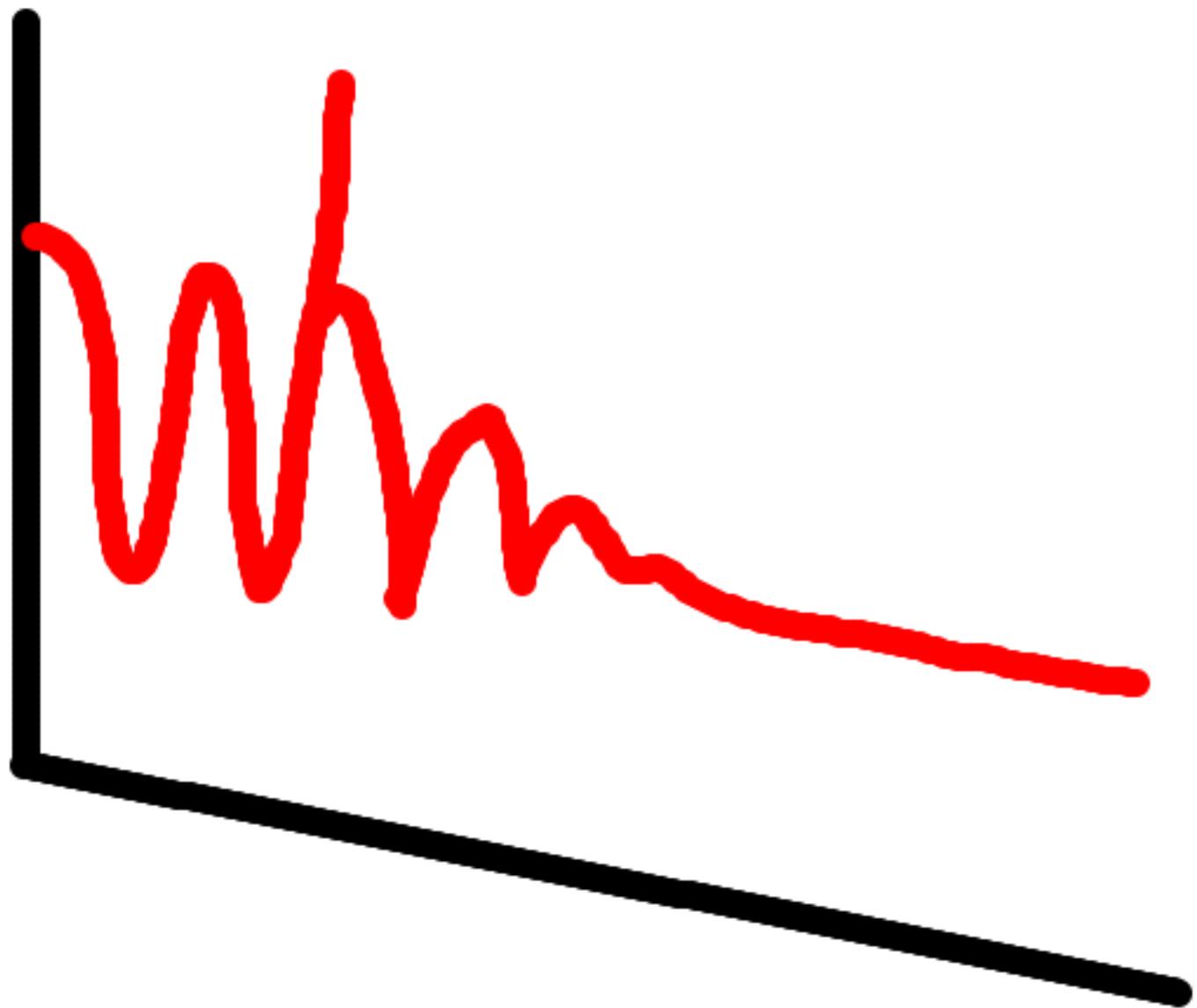


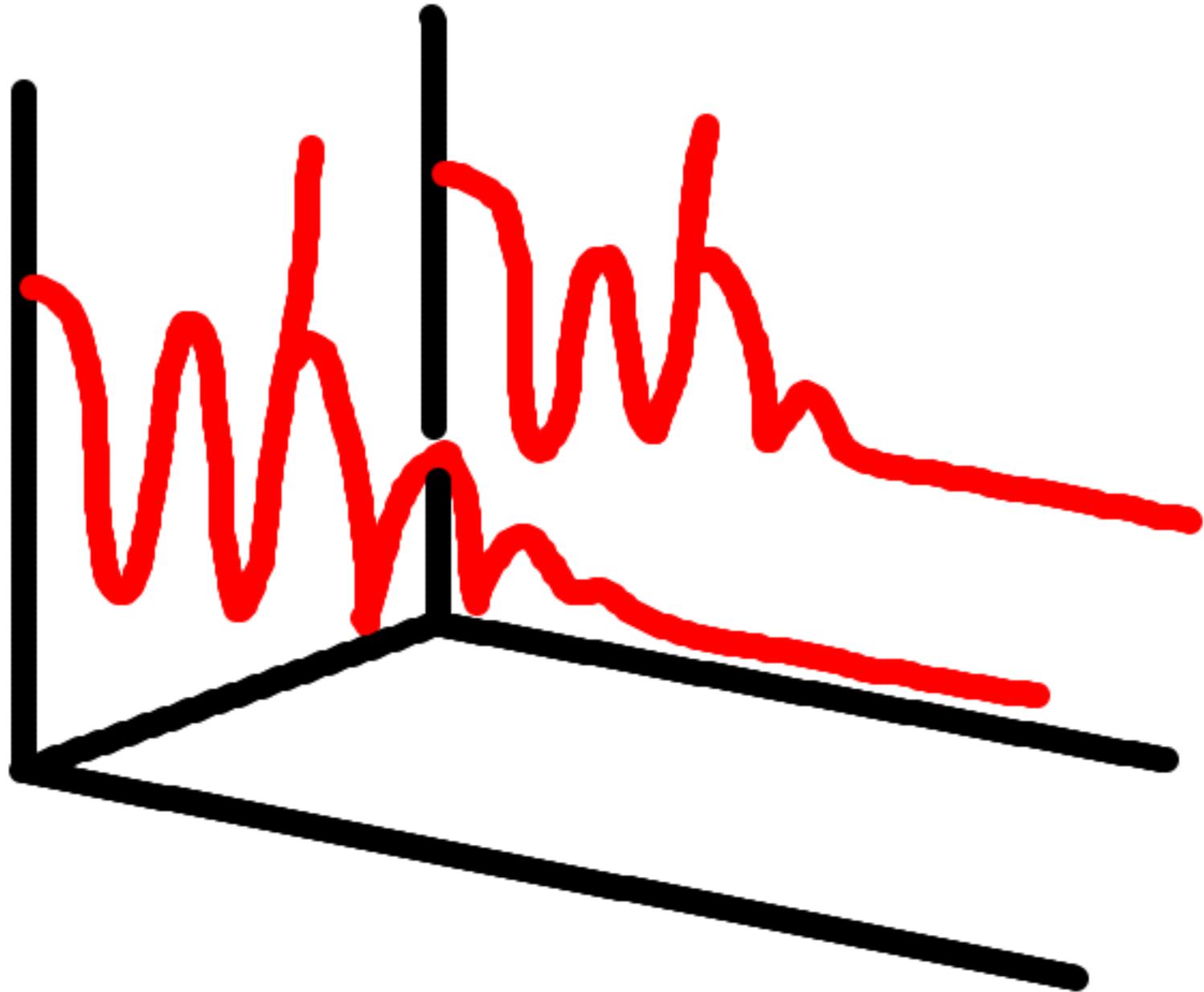
MaxDB 7.500 - Fourier Transform of revisions per day (16384 bins)

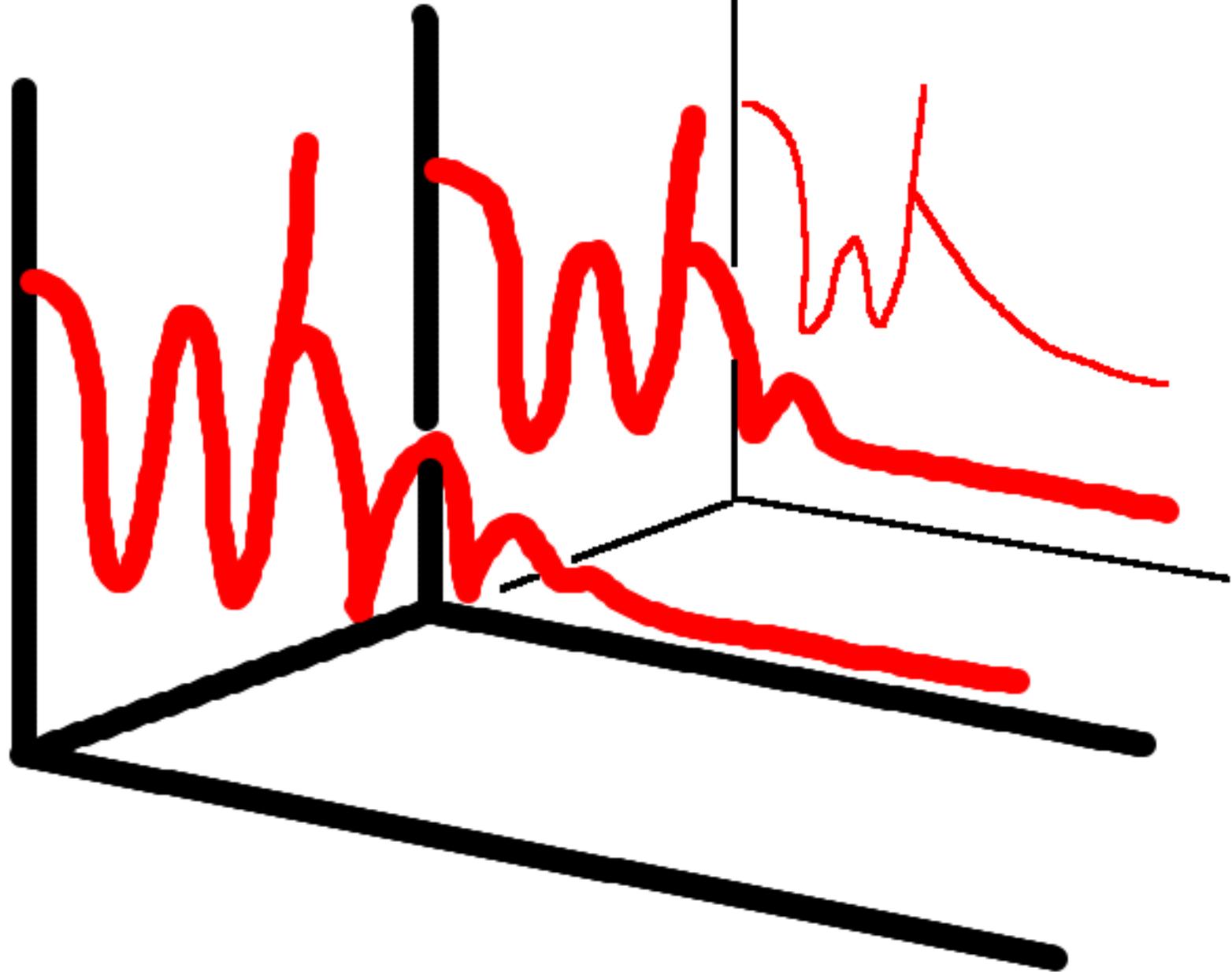


MaxDB 7.500 - Fourier Transform of revisions per day (16384 bins)









Color / Magnitude

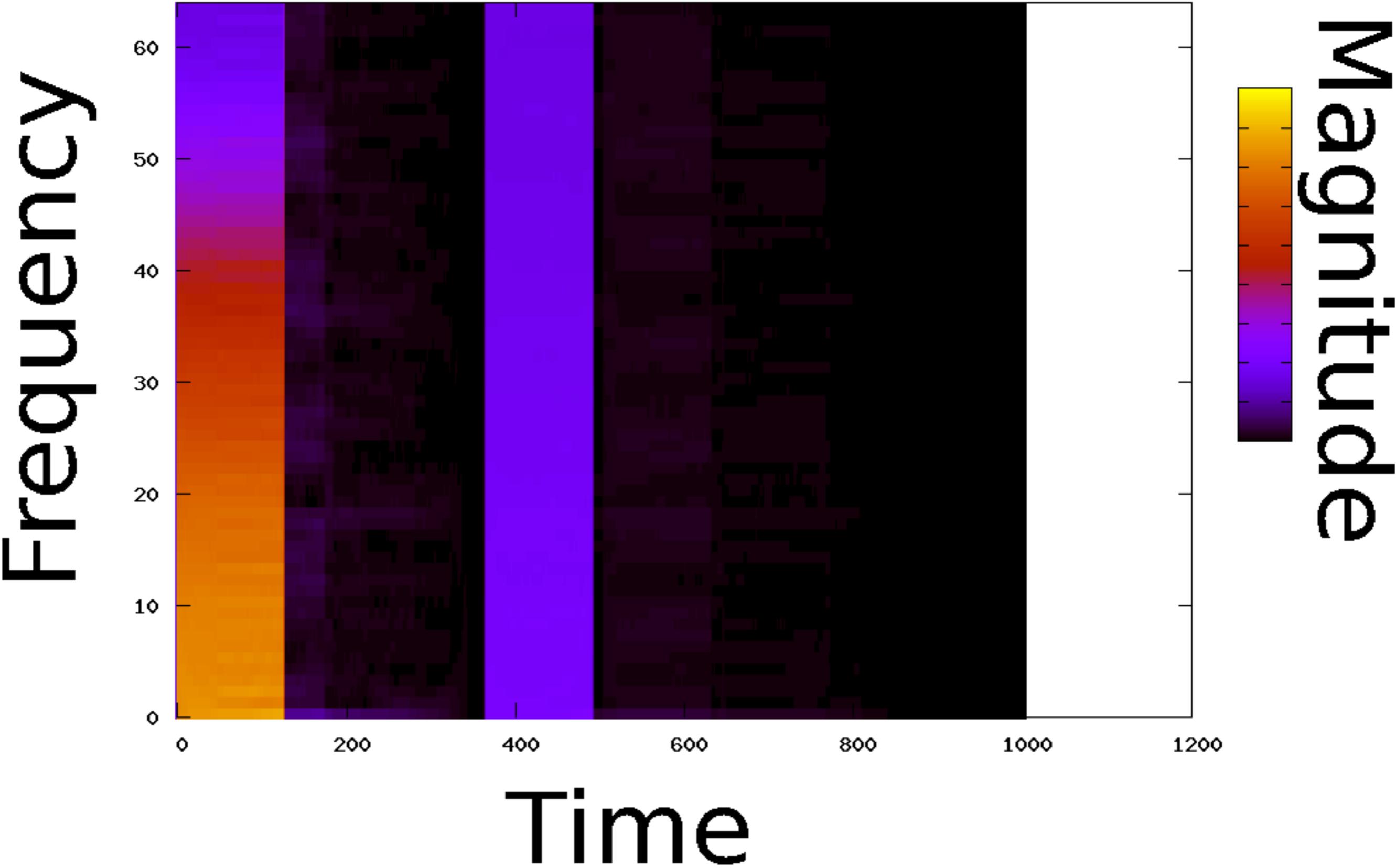


Time/X axis

Magnitude / Y axis

Frequency Domain

Fourier Transform of MaxDB 7.500



MySQL 3.23

MySQL 4.0

MySQL 4.1

MySQL 5.0

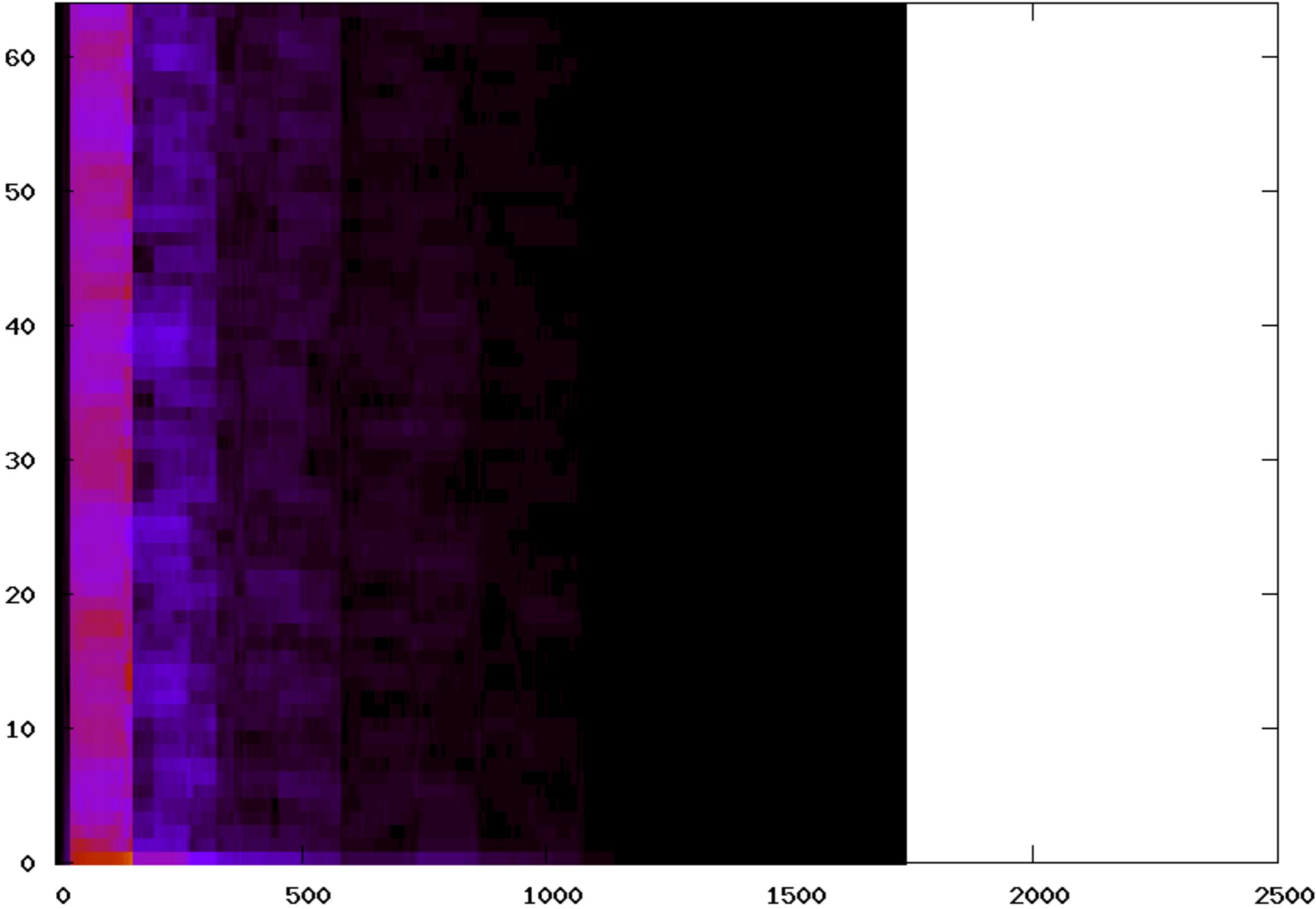
MySQL 5.1



Frequency Domain

Fourier Transform of MySQL 3.23

Frequency



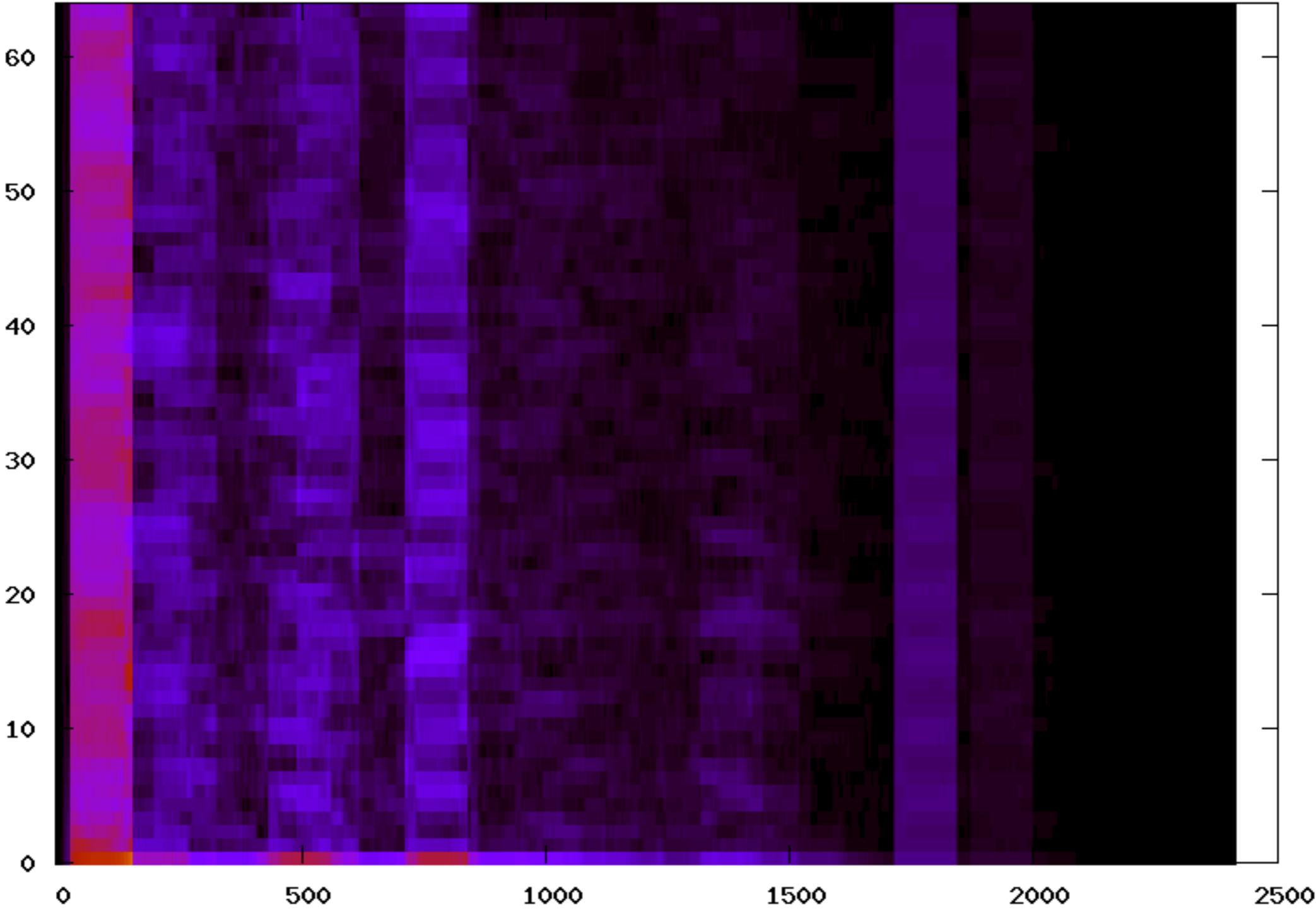
Magnitude

Time

Frequency Domain

Fourier Transform of MySQL 4.0

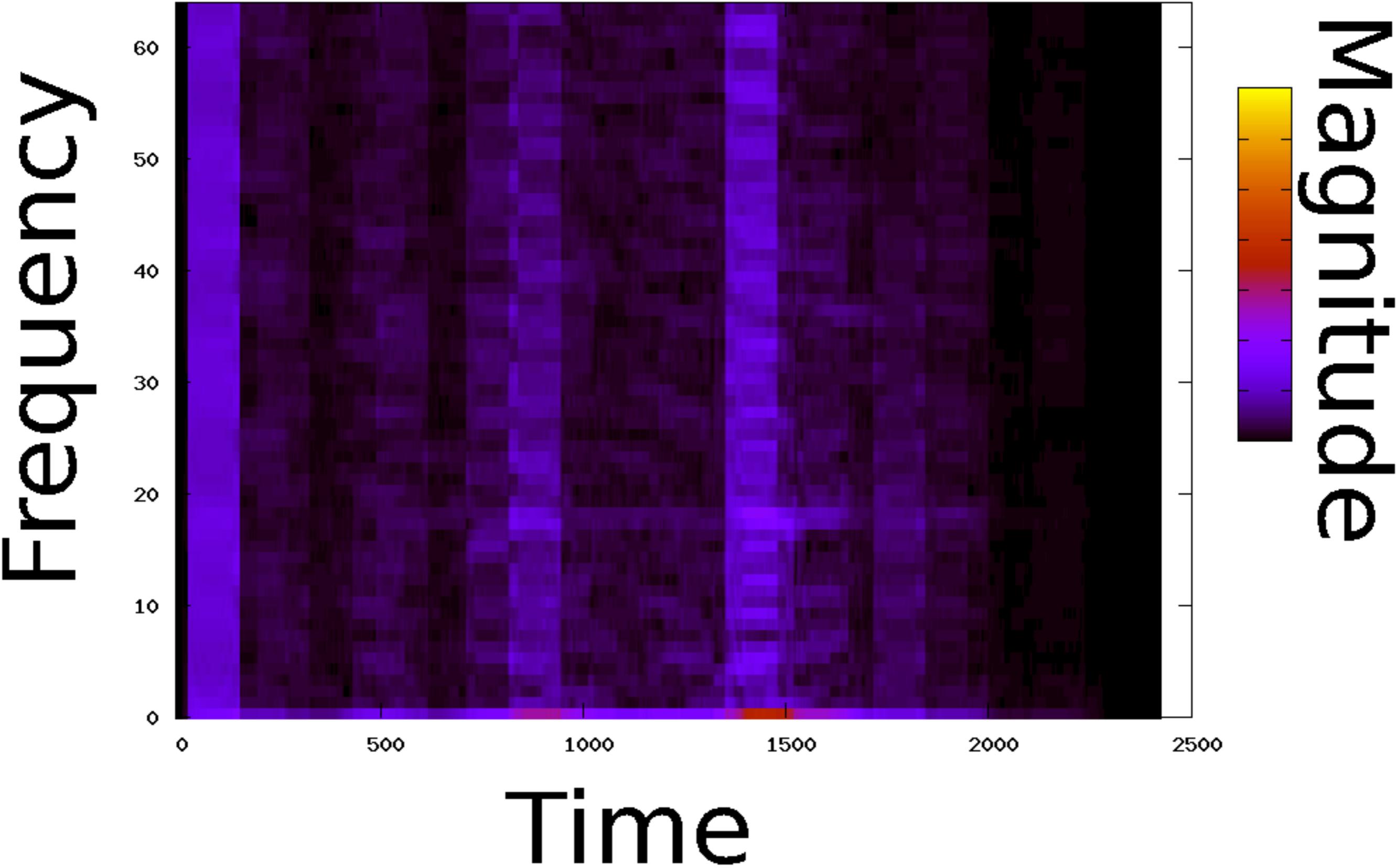
Frequency



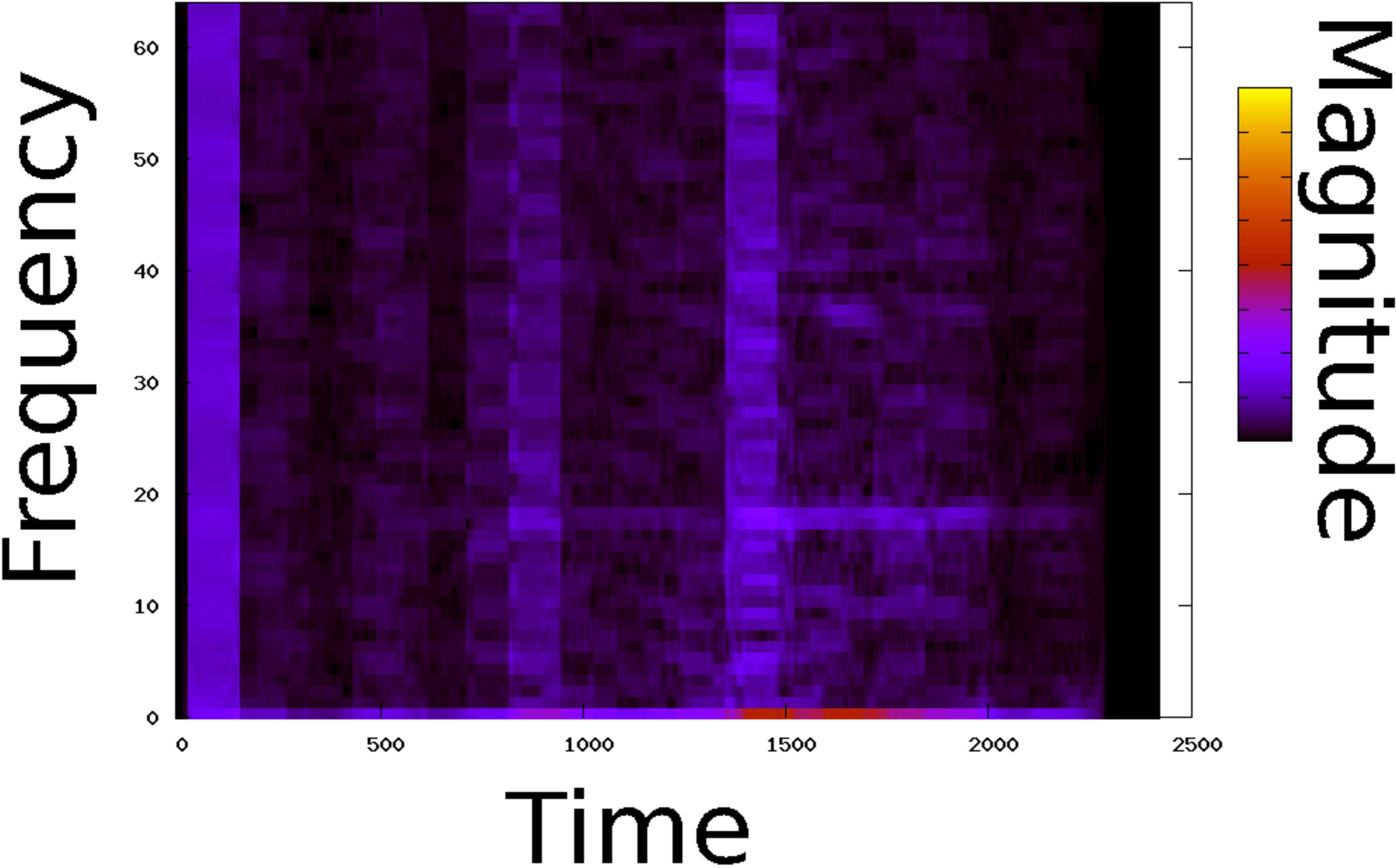
Magnitude

Time

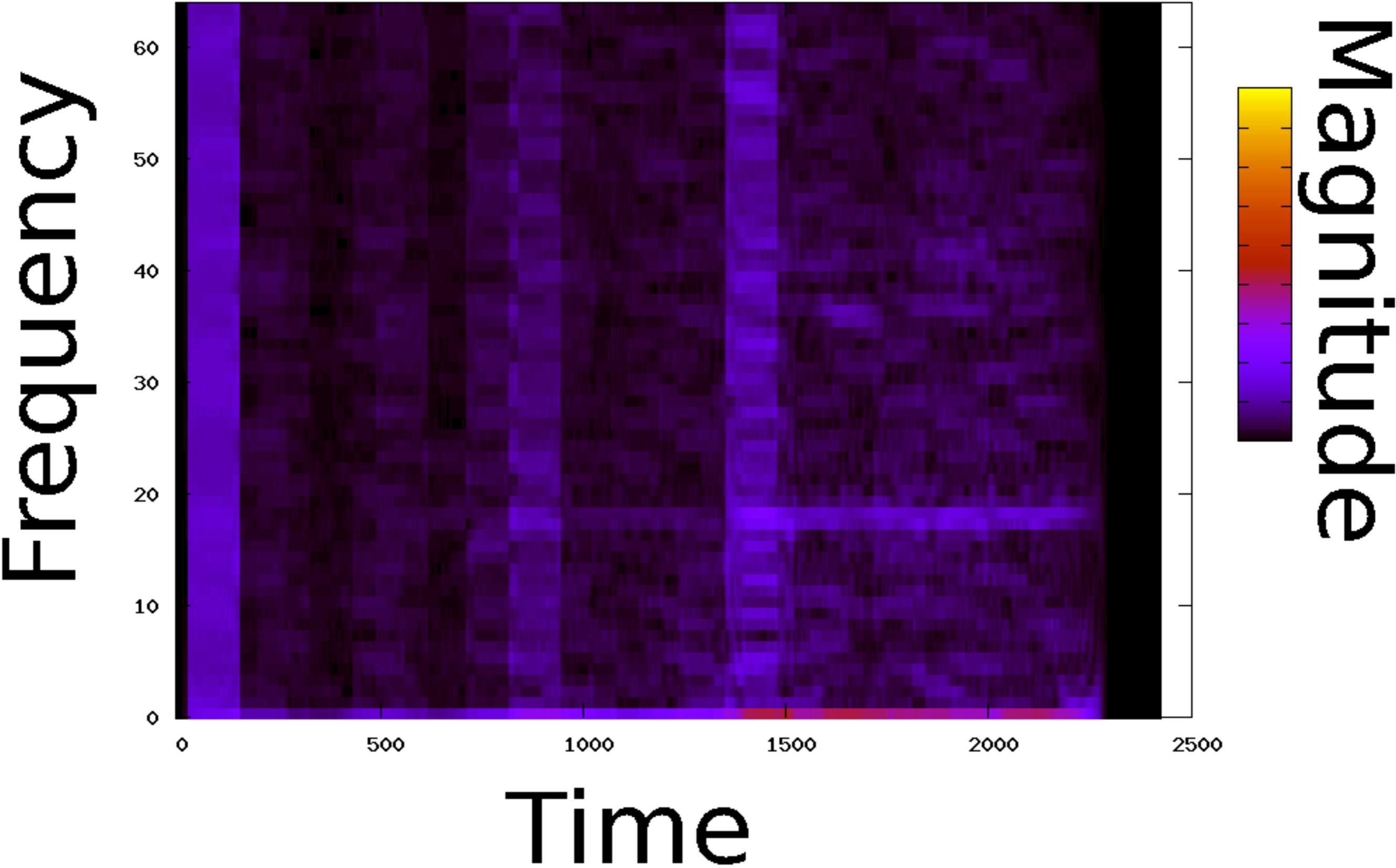
Fourier Transform of MySQL 4.1



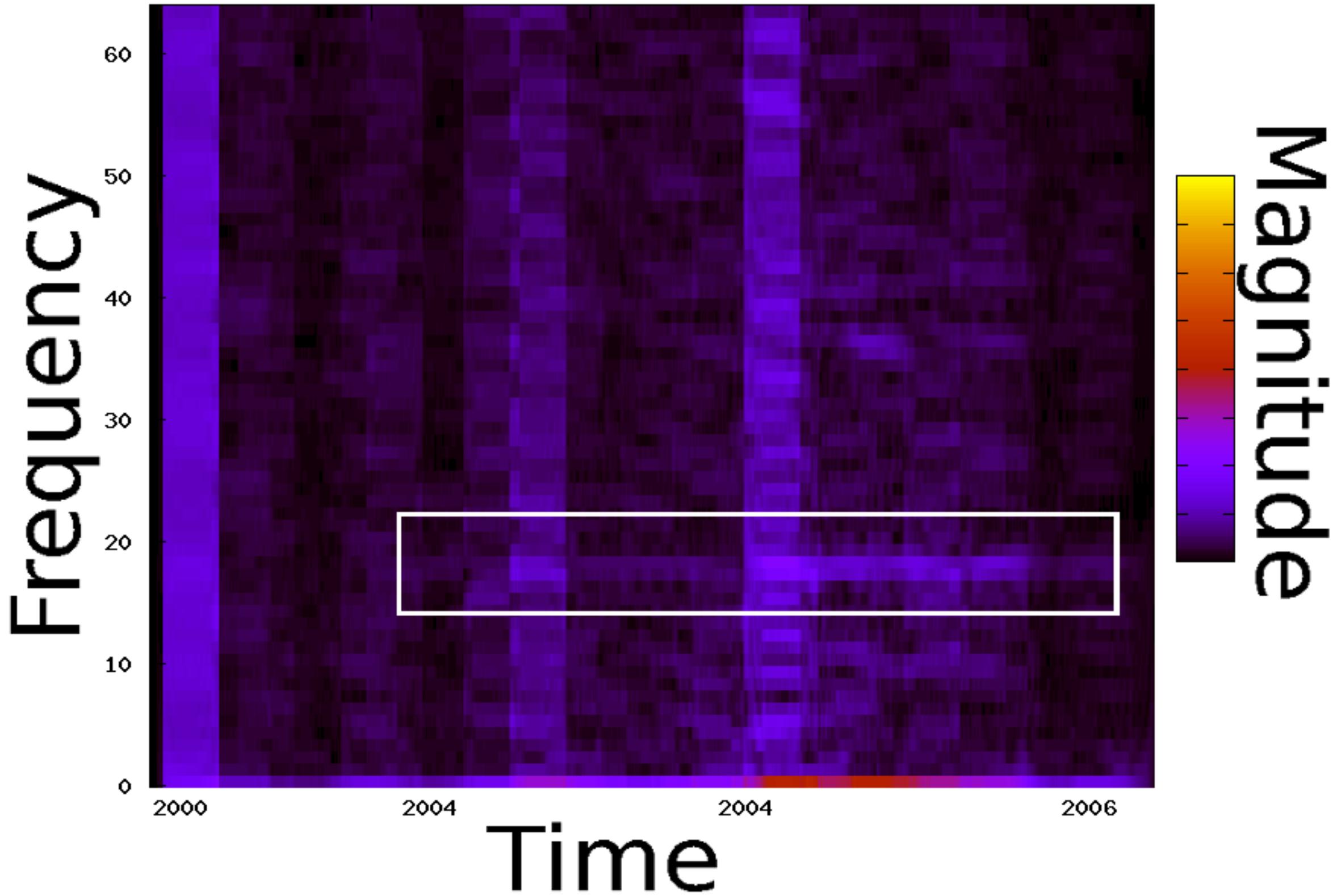
Fourier Transform of MySQL 5.0



Fourier Transform of MySQL 5.1



Fourier Transform of MySQL 5.0



The smears seen
on the MySQL plot
have a period of about
7-8 days (1 week).



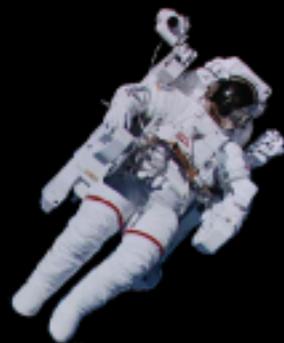
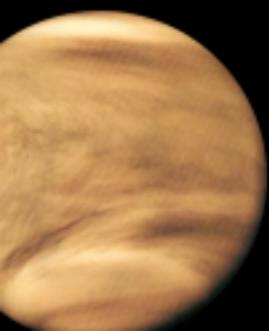
Similar Smears,

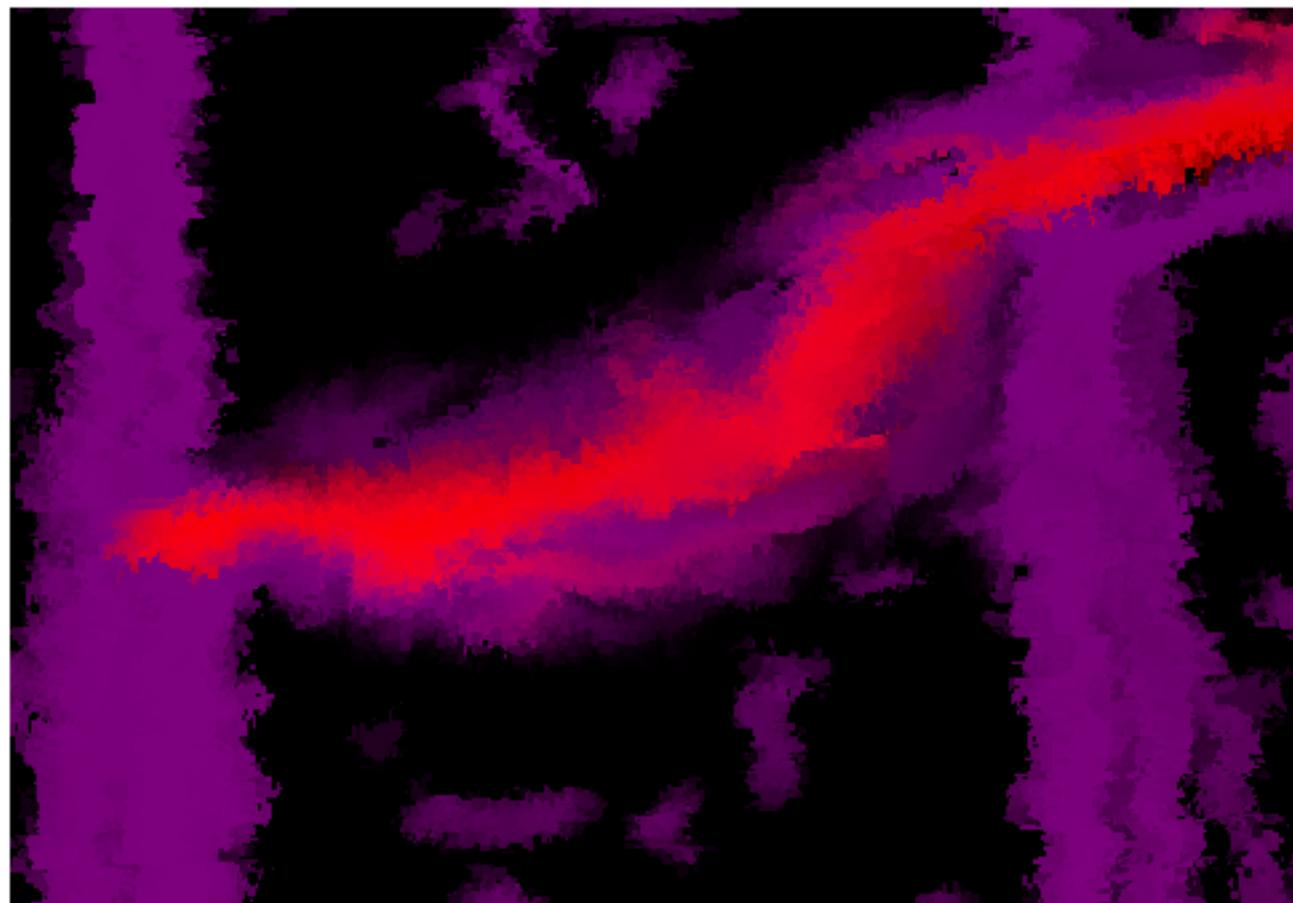
Different Projects

- * Evolution
- * Mozilla
- * Xerces
- * MaxDB 7.6

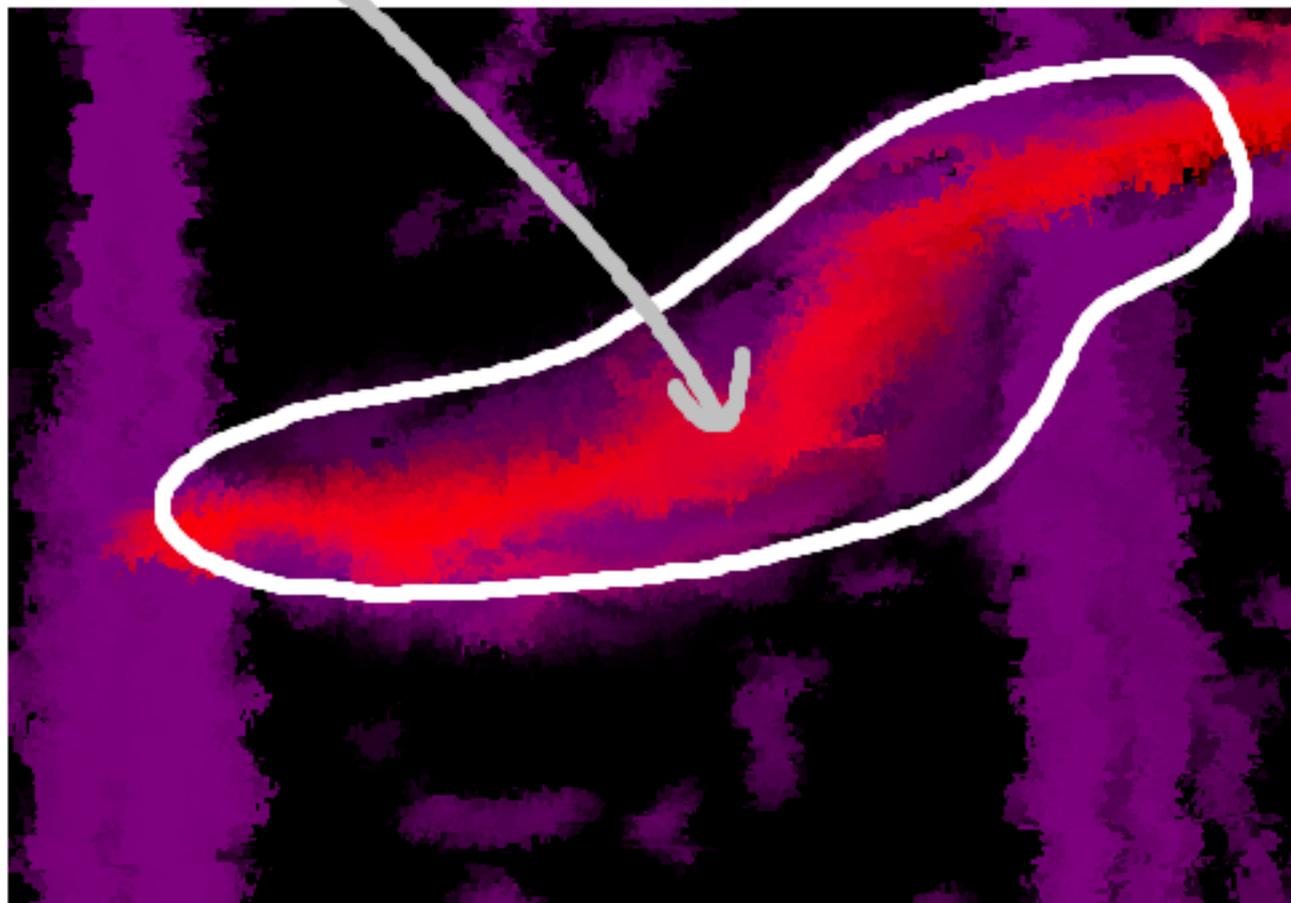


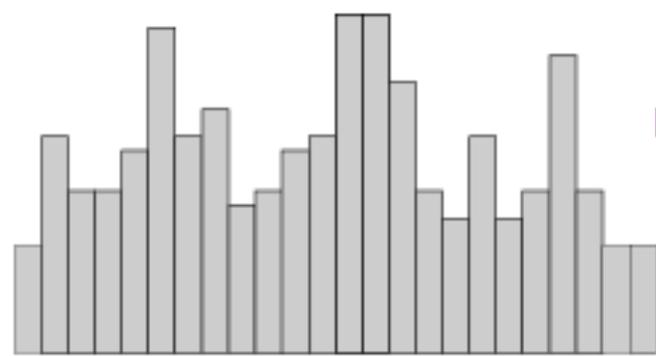
Future Work



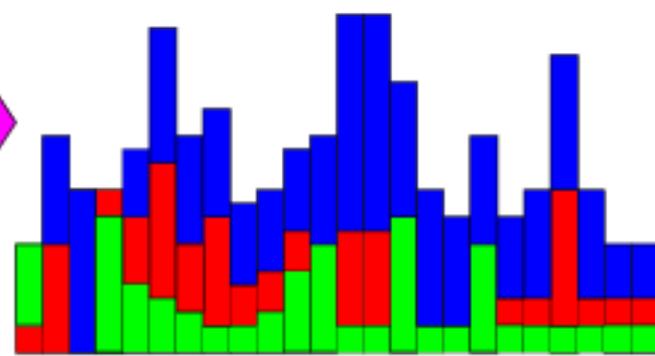


What caused this?

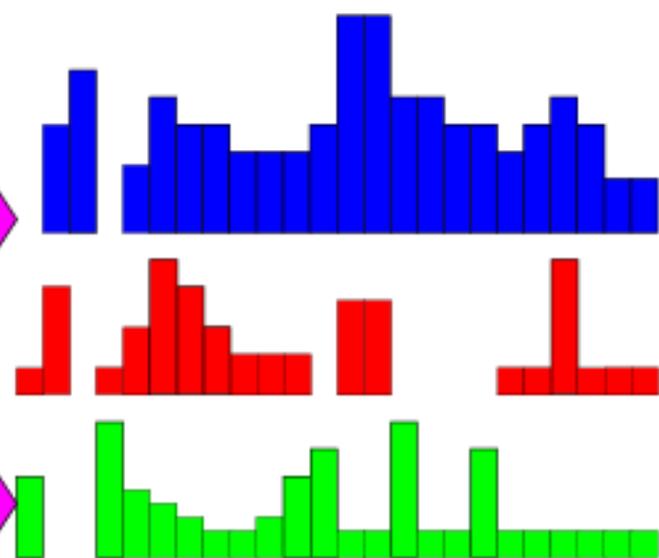




A signal

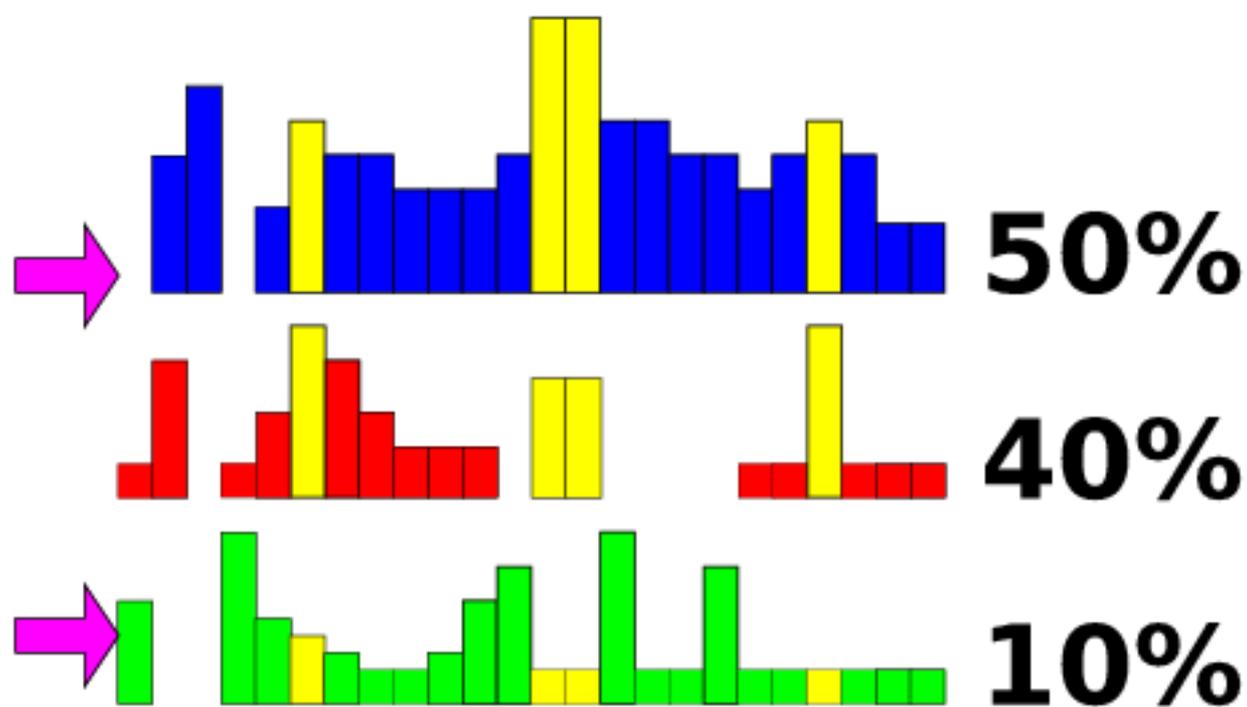
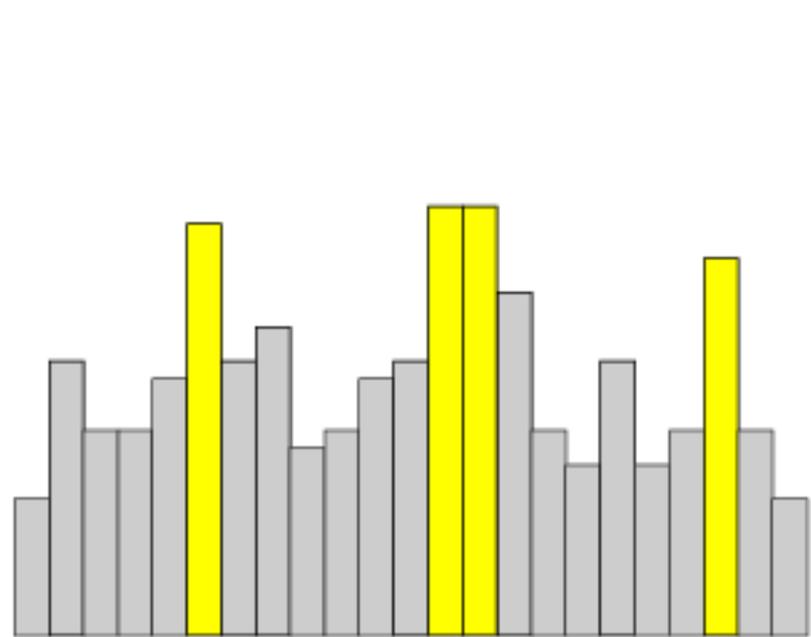


composed



of slices

A signal can be composed of slices



A behaviour explained by slices

Different slices can be responsible for subsignals

A bright sunburst with rays emanating from the top center of the slide.

Contributions:

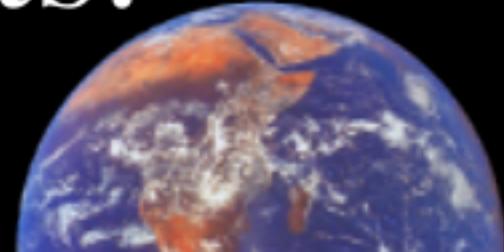
* applied the Fourier transform to software repositories

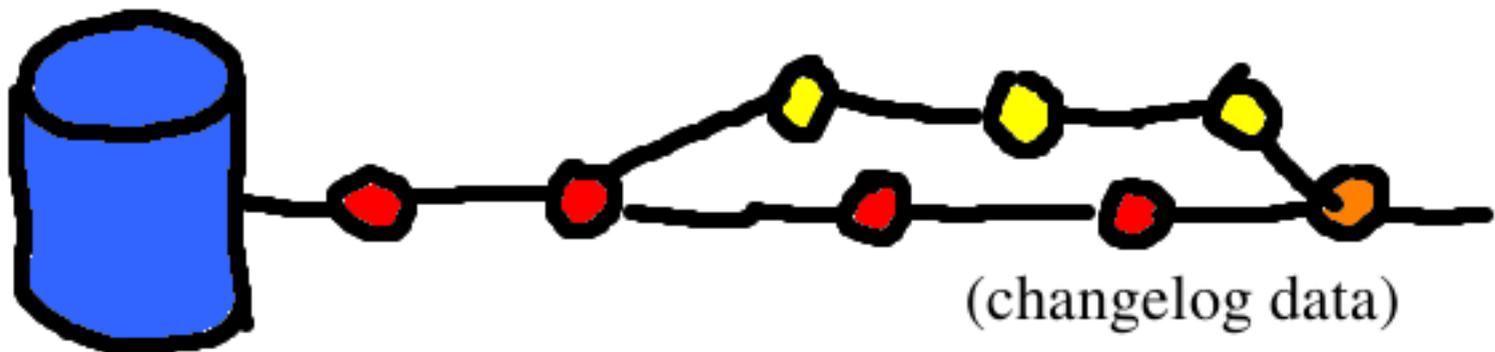


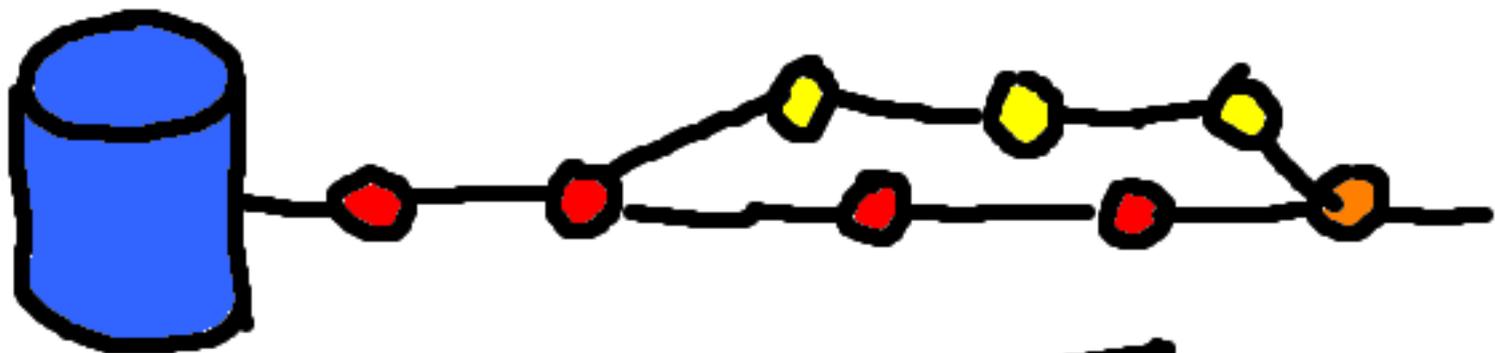
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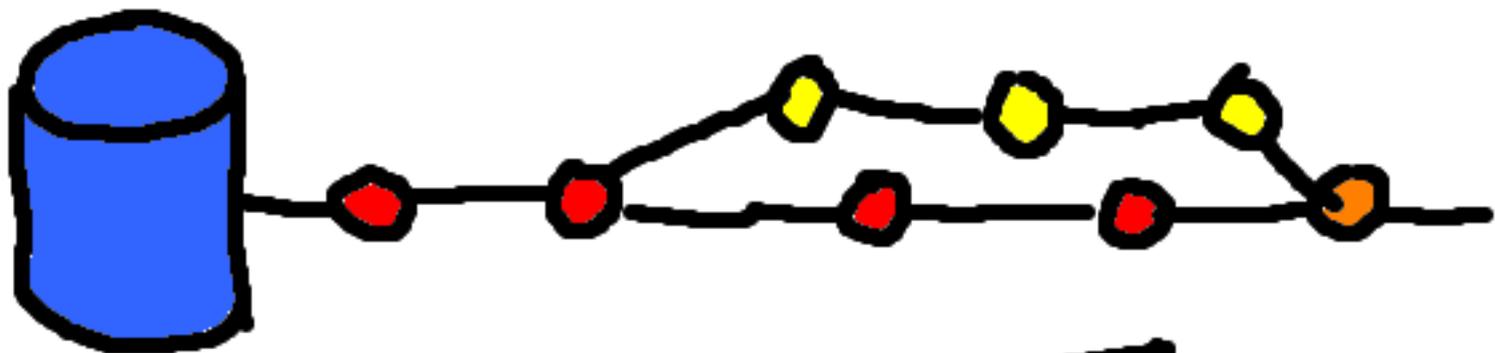
* showed recurrent
behaviour in FLOSS
projects.

A partial view of the Earth showing the continents of Africa and Europe, with blue oceans and white clouds.

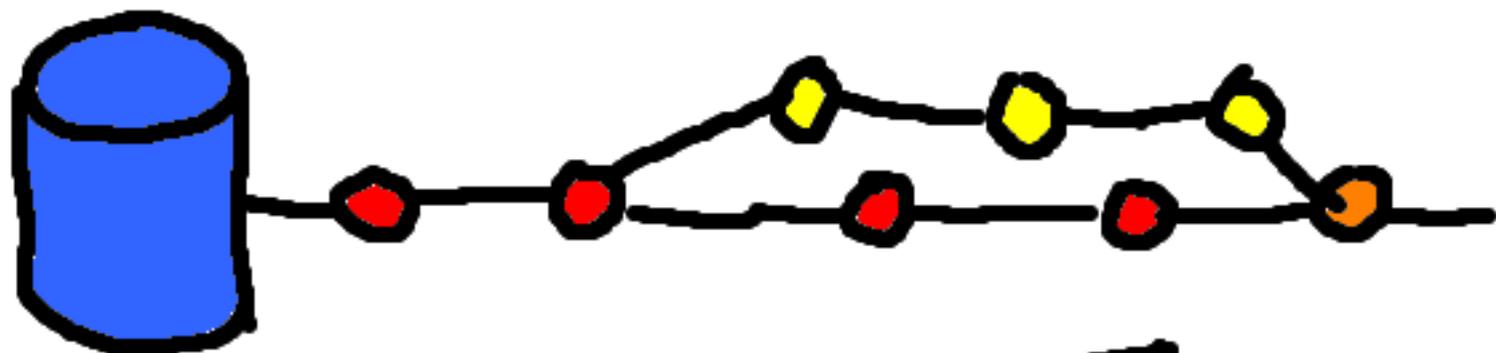




(mailing lists)



(process logs)



(hotspots/profiler)