

# Finansinis Intelektas

[raudys.com/kursas](http://raudys.com/kursas)

Doc. Dr. Aistis Raudys

Vilnius 2018

# Apie ką šis kursas

- Įvadas į finansus ir prekybą
  - Biržos
  - Rinkos duomenys
  - Vertybiniai popieriai
  - Prekyba, sandoriai, brokeriai
- Matematika finansuose
  - Skaičiavimai kiek ir ko pirkti tam tikram tikslui
  - Sukūrimas naujų išvestinių instrumentų (ang. pricing)
  - Duomenų analizė siekiant pelno prekiaujant
  - Rizikos analizė siekiant sumažinti nuostolius
  - Portfelių kūrimas

# Apie ką šis kursas

- Informatika finansuose
  - Programavimas matematikos ↑uždavinių
  - Prekybos sistemų programavimas
  - Labai greitas duomenų apdorojimas
  - Optimizavimas uždavinių naudojant GRID technologijas
  - Sandorių informacinės sistemos
  - Prekybos algoritmai
  - Automatizuotos prekybinės sistemos dalys
  - Automatizuotinos investavimo strategijos

# Mano patirtis

- Praktinė patirtis (6 metai) bankuose Londone
- Kursas 5-ti metai
- Dėstomas iš praktikos
- Pats užsiimu praktika taip pat
- Sritis labai populiarijanti
- Nėra sudėtinga, bet daug detalių
- Tikrai nėra lengvas kelias į praturėjimą

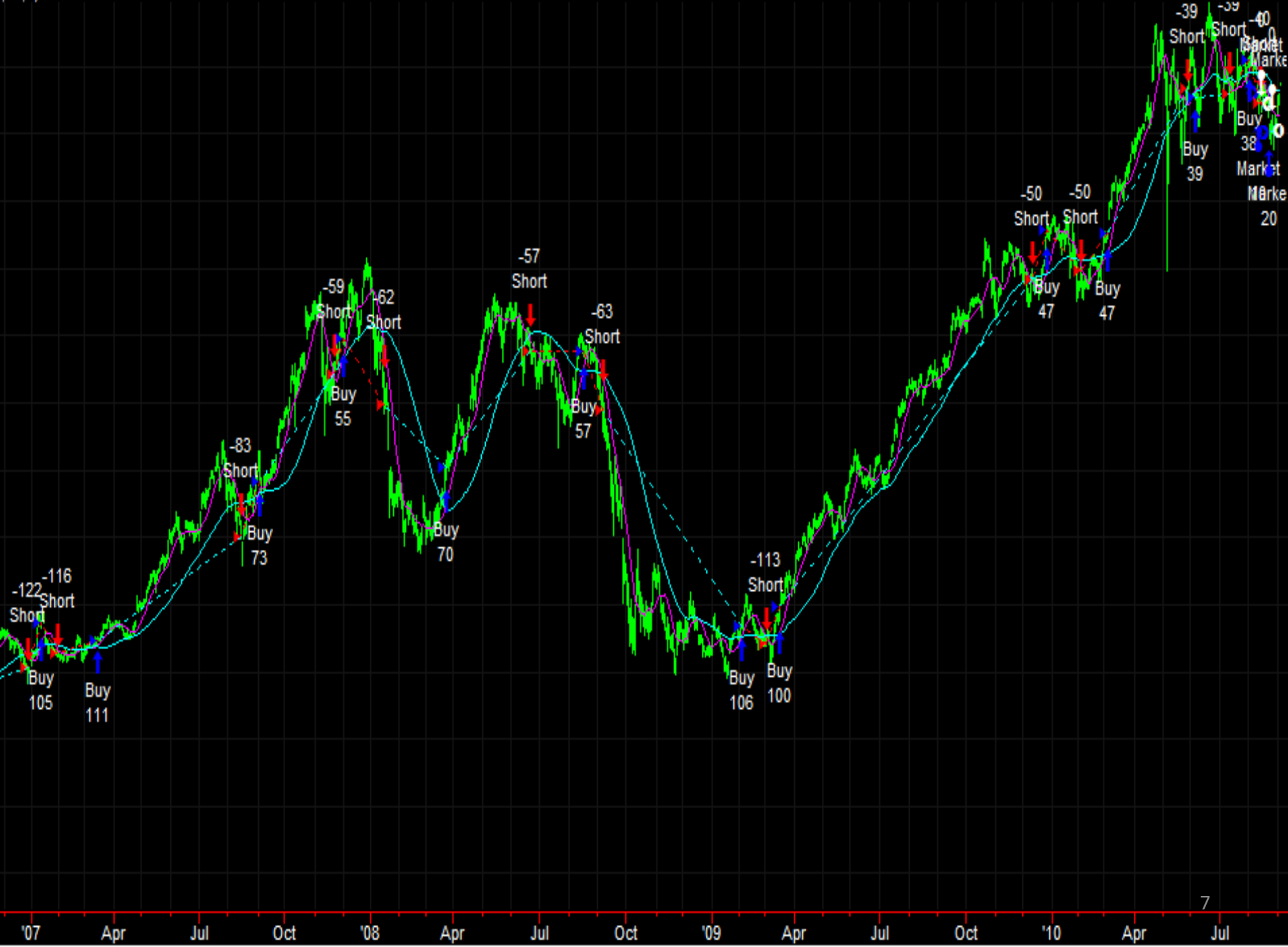
# Mano veikla

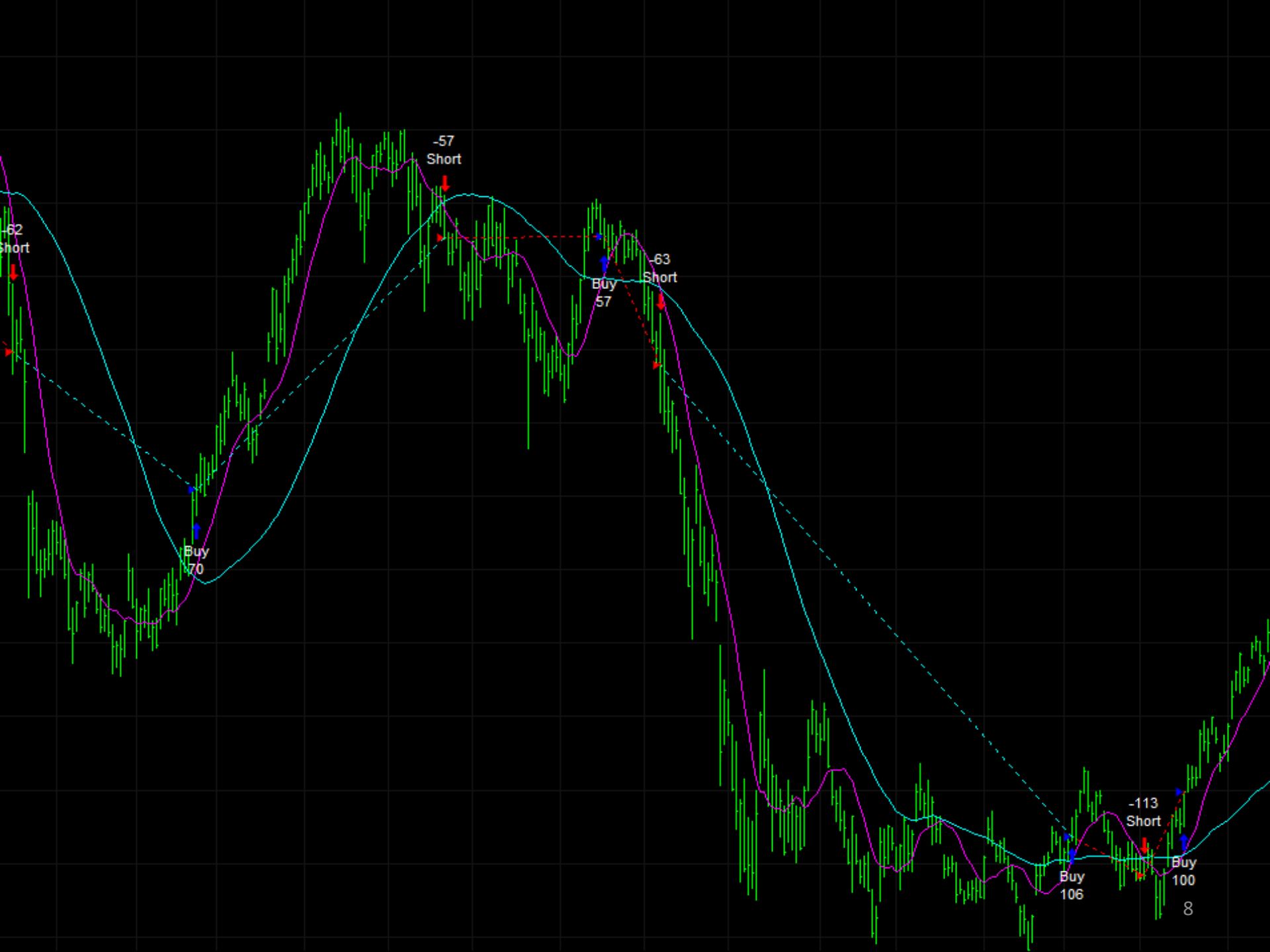
- Dėstau Jums 😊
- Moksliniai tyrimai
  - Vadovauju Lietuvos mokslo tarybos projektui: “Skaitinis intelektas portfelio algoritmų kūrime finansinių sukrėtimų laikotarpiais”
- Vadovauju
  - doktorantams
  - magistrantams
  - bakalaurams
- Mokslinė praktika
- Prekyba ateities sandoriais ir akcijomis “gyvai”
- Su partneriais vystome pirmą algoritminės prekybos fondą LT

# PVZ.:

- Klasikinis techninės analizės pavyzdys, kuris gali būti automatizuotas
- Skaičiuojami 2 slenkantys vidurkiai
  - Trumpas (10 dienu)
  - Ilgas (20 dienų)
- Kai kerta vienas kitą, reikia pirkti arba parduoti

(11,0) 253.15 245.73

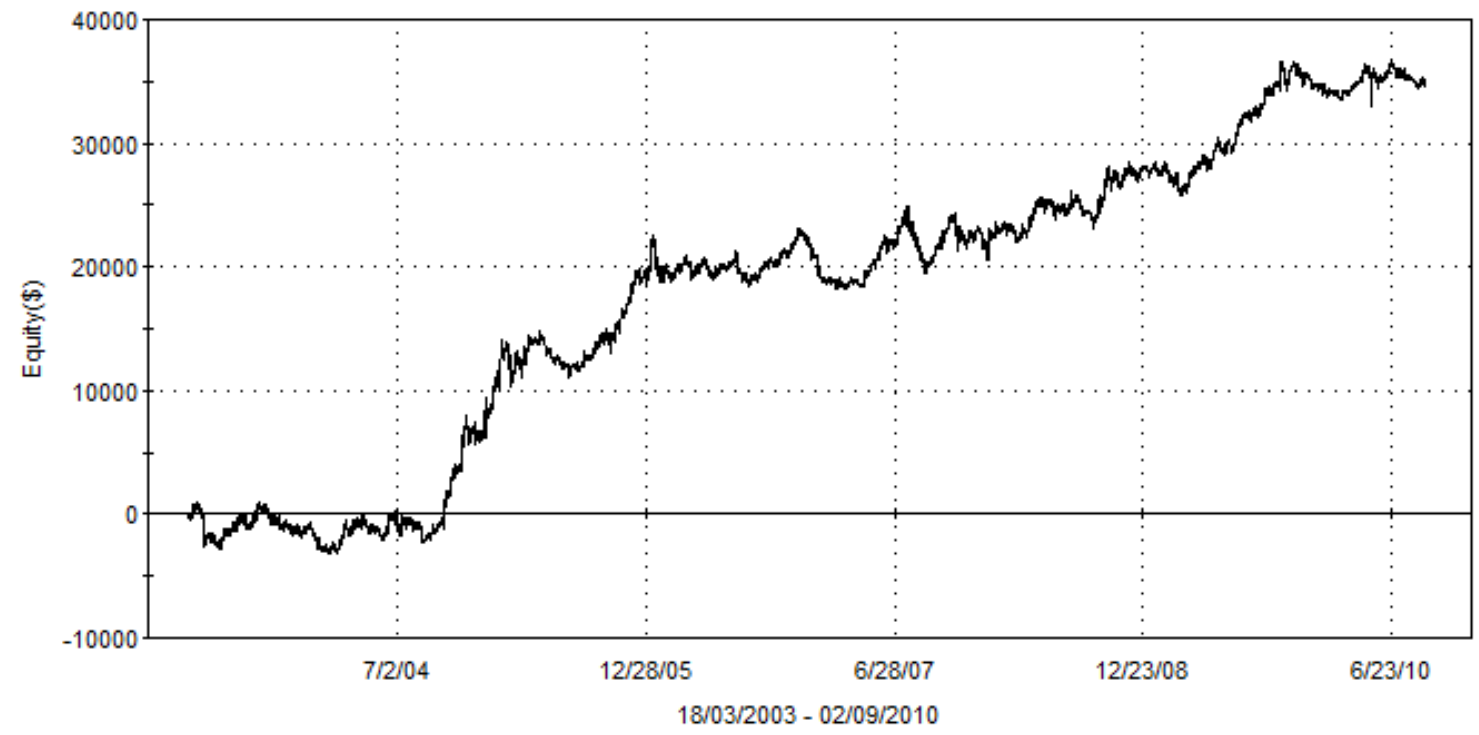






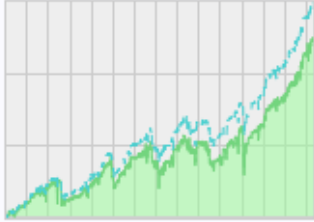
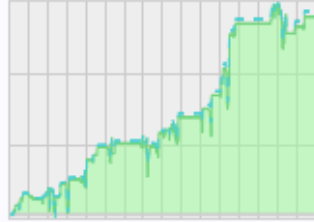

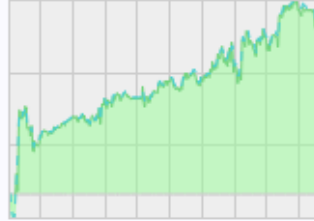
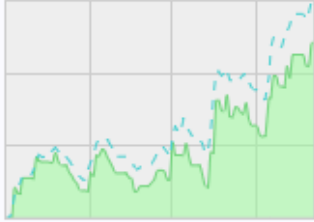

Equity Curve Detailed

Equity Curve Detailed - AAPL Daily(01/03/03 16:00 - 09/02/10 16:00)



# Daugiau sistemy

<http://www.collective2.com>

<p><b>Index Spreads</b></p>  <p>Hypothetical Performance</p> <p>☆ \$ 🔥</p>	<p><b>Options</b> ★★★★★</p> <table border="1"> <tr><td>Age</td><td>1,748 days</td></tr> <tr><td># Trades</td><td>147</td></tr> <tr><td>Avg Trade</td><td>3.8 weeks</td></tr> <tr><td>Win %</td><td>44.9%</td></tr> <tr><td>Ann Retn w comm</td><td>41.8%</td></tr> <tr><td>Correlatn S&amp;P</td><td>0.094</td></tr> <tr><td><b>C2 Score</b></td><td><b>1000</b></td></tr> </table> <p>\$99 / month</p> <p>About Featured Systems ?</p>	Age	1,748 days	# Trades	147	Avg Trade	3.8 weeks	Win %	44.9%	Ann Retn w comm	41.8%	Correlatn S&P	0.094	<b>C2 Score</b>	<b>1000</b>	<p><b>sp500-trading.com</b></p>  <p>Hypothetical Performance</p> <p>\$ 🔥</p>	<p><b>Futures</b> ★★★★★</p> <table border="1"> <tr><td>Age</td><td>985 days</td></tr> <tr><td># Trades</td><td>39</td></tr> <tr><td>Avg Trade</td><td>6.2 days</td></tr> <tr><td>Win %</td><td>76.9%</td></tr> <tr><td>Ann Retn w comm</td><td>96.2%</td></tr> <tr><td>Correlatn S&amp;P</td><td>0.287</td></tr> <tr><td><b>C2 Score</b></td><td><b>997</b></td></tr> </table> <p>\$85 / month</p> <p>10 day free trial</p>	Age	985 days	# Trades	39	Avg Trade	6.2 days	Win %	76.9%	Ann Retn w comm	96.2%	Correlatn S&P	0.287	<b>C2 Score</b>	<b>997</b>
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<p><b>Smooth Fund</b></p>  <p>Hypothetical Performance</p>	<p><b>Stocks</b></p> <table border="1"> <tr><td>Age</td><td>398 days</td></tr> <tr><td># Trades</td><td>10</td></tr> <tr><td>Avg Trade</td><td>34.9 weeks</td></tr> <tr><td>Win %</td><td>50.0%</td></tr> <tr><td>Ann Retn w comm</td><td>7.9%</td></tr> <tr><td>Correlatn S&amp;P</td><td>-0.215</td></tr> <tr><td><b>C2 Score</b></td><td><b>916</b></td></tr> </table> <p>\$29 / month</p> <p>30 day free trial</p>	Age	398 days	# Trades	10	Avg Trade	34.9 weeks	Win %	50.0%	Ann Retn w comm	7.9%	Correlatn S&P	-0.215	<b>C2 Score</b>	<b>916</b>	<p><b>VeePo ES Custom</b></p>  <p>Hypothetical Performance</p> <p>\$ 🔥 100</p>	<p><b>Futures</b> ★★★★★</p> <table border="1"> <tr><td>Age</td><td>293 days</td></tr> <tr><td># Trades</td><td>21</td></tr> <tr><td>Avg Trade</td><td>1.9 weeks</td></tr> <tr><td>Win %</td><td>61.9%</td></tr> <tr><td>Ann Retn w comm</td><td>55.2%</td></tr> <tr><td>Correlatn S&amp;P</td><td>0.201</td></tr> <tr><td><b>C2 Score</b></td><td><b>994</b></td></tr> </table> <p>\$150 / month</p> <p>14 day free trial</p>	Age	293 days	# Trades	21	Avg Trade	1.9 weeks	Win %	61.9%	Ann Retn w comm	55.2%	Correlatn S&P	0.201	<b>C2 Score</b>	<b>994</b>
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<p><b>Whole Wheat</b></p>  <p>Hypothetical Performance</p> <p>\$</p>	<p><b>Futures</b></p> <table border="1"> <tr><td>Age</td><td>114 days</td></tr> <tr><td># Trades</td><td>68</td></tr> <tr><td>Avg Trade</td><td>39.3 mins</td></tr> <tr><td>Win %</td><td>44.1%</td></tr> <tr><td>Ann Retn w comm</td><td>127.1%</td></tr> <tr><td>Correlatn S&amp;P</td><td>0.017</td></tr> <tr><td><b>C2 Score</b></td><td><b>992</b></td></tr> </table> <p>\$129.99 / month</p> <p>7 day free trial</p>	Age	114 days	# Trades	68	Avg Trade	39.3 mins	Win %	44.1%	Ann Retn w comm	127.1%	Correlatn S&P	0.017	<b>C2 Score</b>	<b>992</b>	<p><b>WSS_Gold100oz</b></p>  <p>Hypothetical Performance</p> <p>\$ 🔥</p>	<p><b>Futures</b> ★★★★★</p> <table border="1"> <tr><td>Age</td><td>497 days</td></tr> <tr><td># Trades</td><td>268</td></tr> <tr><td>Avg Trade</td><td>1.8 days</td></tr> <tr><td>Win %</td><td>51.5%</td></tr> <tr><td>Ann Retn w comm</td><td>164.3%</td></tr> <tr><td>Correlatn S&amp;P</td><td>-0.038</td></tr> <tr><td><b>C2 Score</b></td><td><b>999</b></td></tr> </table> <p>\$300 / month</p> <p>15 day free trial</p>	Age	497 days	# Trades	268	Avg Trade	1.8 days	Win %	51.5%	Ann Retn w comm	164.3%	Correlatn S&P	-0.038	<b>C2 Score</b>	<b>999</b>
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# Demo prekybos sistema

<http://raudys.com/kursas/pratybos/jts.zip>

Login/pass: edemo/demouser

Contract	Last Action	Change Quantity	Change (%) Time in Force	Bid Size Type	Bid Lmt Price	Ask Destination	Ask Size Transmit	Position Status	Avg Price Trd Prc	P&L Cancel
USD.CAD	0.9778 <sup>5</sup>			7M	0.9778 <sup>0</sup>	0.9779 <sup>0</sup>	6M			
USD.CHF	0.94057			9M	0.9405 <sup>0</sup>	0.9406 <sup>5</sup>	9M			
USD.HKD	• 7.7516			7M	• 7.7514	7.7517	• 6M			
USD.JPY	• 77.46 <sup>5</sup>			10M	• 77.46 <sup>0</sup>	77.47 <sup>0</sup>	• 10M			
AUD.USD	• 1.0095 <sup>5</sup>			4.8M	• 1.0095 <sup>0</sup>	1.0096 <sup>0</sup>	• 800K			
EUR.USD	• 1.2775 <sup>5</sup>			9M	• 1.2775 <sup>0</sup>	1.2776 <sup>0</sup>	• 9M			
GBP.USD	• 1.6014 <sup>0</sup>			9M	• 1.6013 <sup>0</sup>	1.6015 <sup>0</sup>	• 8M			
YM Sep'12 @EC...	• 13438	+24	0.18%	9	13438	13440	13			
ZB Sep'12 @ECB...	• 150'200	+0'150	0.31%	192	• 150'200	150'220	• 320			
ZN Sep'12 @EC...	• 134'110	+0'015	0.03%	30	134'110	134'120	2			
ES Sep'12 @GL...	• 1431.00	+0.25	0.02%	350	1431.00	1431.50	• 870			
EUR Sep'12 @G...	• 1.2781	-0.0014	-0.11%	36	• 1.2781	1.2783	• 32			
GE Sep'12 @GL...	99.5975	0.0000	0.00%	20,899	99.5975	99.6050	1,091			
NQ Sep'12 @GL...	• 2824.75	+1.75	0.06%	12	• 2824.75	2825.25	• 16			
DAX Sep'12 @DTB	• 7007.00	-22.50	-0.32%	5	• 7007.00	7008.00	• 5			
ESTX50 Sep'12 ...	• 2596.00	-1.00	-0.04%	217	• 2595.00	2596.00	• 507			
I Sep'12 @LIFFE	• 99.790	+0.015	0.02%	46,411	99.790	99.795	38,128			

Last Login: Sep 10, 04:05 Market data 09:37:25

# Metatrader

13: MetaTrader - USDJPY\_M30

File View Insert Charts Tools Window Help

Market Watch: 18:36

Symbol	Bid	Ask
USDCHF	1.5318	1.5323
GBPUSD	2.6703	2.6708
EURUSD	0.9102	0.9107
USDJPY	65.75	65.80

Navigator

- MetaTrader
  - Accounts
    - 13: John Smith
  - Indicators
  - Expert Advisors
  - Custom Indicators
  - Scripts

Data Window

Date	04.11.20	04.11.05
Time	16:00	04:00
Open	2.6882	1.9906
High	2.6894	2.0102
Low	2.6545	1.9844
Close	2.6704	2.0026
Volume	93376	143784
SAR	2.6249	1.8424

USDJPY\_M30

GBPUSD\_H4

USDCHF\_M5

EURUSD\_M15

Ticket

Ticket	Time	Type	L...	Symbol	Price	S / L	T / P	Time	Price	Comm	Swap	Profit	Comment
21	2004.11.20 18:00	balance	Deposit									5000.00	

Profit/Loss: 0.00 Deposit/Withdrawal: 5000.00 Credit Facility: 0

Trade | News | Account History | Alerts | Mailbox | Experts | Journal

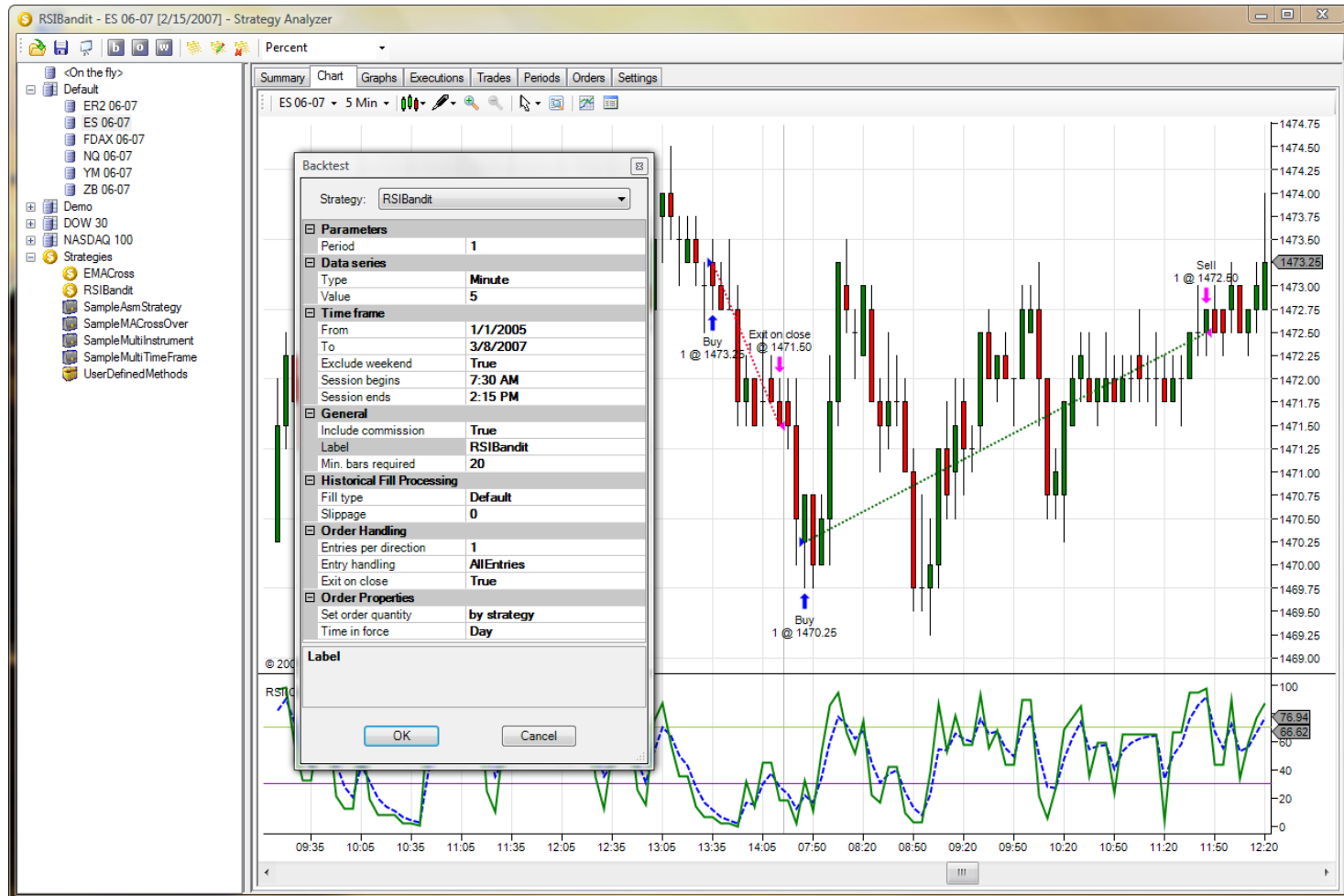
For Help, press F1

Default

1337/1 kb

# Ninja Trader

Nemokama sistema simuliacijoms, galima programuoti c# kalba

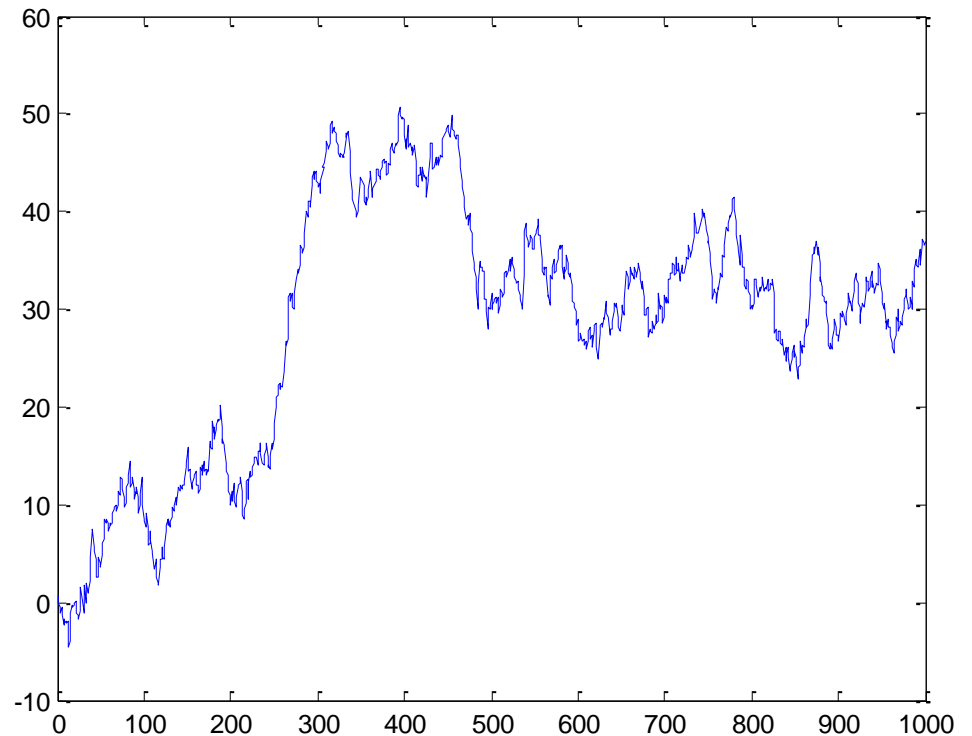


# MATLAB

- Nepamainomas duomenų analizės įrankis
- Plačiai naudojamas finansuose
- Labai patogus bet kokių duomenų
  - Analizei
  - Manipuliavimui
  - Vizualizavimui
- Greitas ir patogus prototipų kūrimas
- Yra nekomercinė versija “GNU Octave”
  
- Alternatyva yra **R**
- Alternatyva yra **Pythonas**

# PVZ.:

```
%% pratybos000.m  
  
x = randn(1,1000);  
% arba load data_file  
  
figure(1);plot(cumsum(x));
```



# Darbai susiję su finansais

- Populiariausios vietos
  - Londonas, Niujorkas
  - Frankfurtas, Ciurichas, Honkongas, Paryžius, Singapūras
- Kokių specialistų ieško darbdaviai
  - Programuotojų
  - Matematikų/statistikų
  - Rinkos analitikų/sistemų kūrėjų
  - O labiausiai tokių, kurie išmano viską



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You refined by  
matlab [undo]  
UK [undo]  
Undo all

Showing 1-30 of 30 jobs

Sort by [Relevance](#) | [Date](#) | [Company](#) | [Location](#)

**C++ Quantitative Developer – Ultra Low Latency HFT Strategies**

**Selby Jennings Technology**

UK-London

31 Aug 12

Circa £100,000-£120,000 + bonus + benefi...

Proprietary Trading Firm – the City of London, London, UK Circa £100,000-£120,000 + bonus + benefits

**Quant Researcher - Systematic Hedge Fund**

**Huxley Associates**  
£60000 - £85000 per annum + Benefits

UK-London

24 Aug 12

I am working on a search for an exceptional Statistician to join the Quantitative Research & Analysis team...

**Market Risk Control Business Analyst**

**Robert Walters**  
£65k

UK-London

16 Aug 12

The Business Analyst, Stress test calibration role sits within the Market Risk Management and Control function...

## Front Office Quant, Rates, FX & Hybrids (AVP / VP)

 Salary:	Circa £200k total.
 Location:	London, England, United Kingdom
 Job Type:	Permanent, Full time
 Company:	Millar Associates
 Posted on:	06 Feb 18

**336**  
views of this  
job

**This truly global top-tier investment bank trades and structures a range of products across FX, Rates, Credit, Structured Finance & Equity-linked products. They now seek a very talented Quant Analyst for their Global Quant Analytics group. Sitting in the Front Office with the traders, you will work on the modeling of Rates, Credit and FX Derivative and Cash products.**

### KEY RESPONSIBILITIES:

- Build & implement pricing models for Credit and Rates-linked Derivative & Cash products
- Maintaining existing models
  - Document & testing new and existing models
- Support the analytics model library for the quants, trading, Risk & Finance

### KEY SKILLS & EXPERIENCE:

- Strong analytic, modelling, pricing & risk management skills gained in finance
- Strong programming using C++, Python, Matlab, R, S-Plus, C++, SQL
- Understanding of Rates, Credit or FX products gained on the job or within education
- Experience gained either at a bank or at a Risk software house developing derivative pricing models
- Minimum MSc, ideally a PhD in Finance, Maths, Physics, Comp Sci, Econometrics, Stats or Engineering
- The ability to communicate effectively across multiple teams with good presentational skills
- Able to multi-task different projects and prioritise against tight deadlines
- Available for occasional international travel

## C++ Quantitative Developer – Ultra Low Latency HFT Strategies

Company	Selby Jennings Technology
Location	UK-London
Remuneration	Circa £100,000-£120,000 + bonus + benefits
Position Type	Permanent
Employment type	Full time
Updated	31-Aug-2012
eFC Ref no	1088764

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**Proprietary Trading Firm – the City of London, London, UK Circa  
£100,000-£120,000 + bonus + benefits**

- ***Senior C++ Quantitative Developer – Ultra Low Latency HFT Strategies, Proprietary Trading Firm – the City of London, London, UK will require the following skill-set;***
  - Exceptional C++ programming skills
  - Secondary knowledge of Java a big plus
  - Experience with ultra-low-latency production code
  - Knowledge of large datasets
  - SQL
  - Multithread experience
  - Matlab/R
  - Deep knowledge of FX, Futures, Equities a plus but not prerequisite
  - BSc (or higher) in Comp Sci, Maths, Physics, Engineering etc
  - Solid communication
  - Python/Perl/Bash



33 jobs for **matlab**

[Classic View](#)



Sort: [Best Match](#)

**Matlab Developer**

£350 per Day  
London  
Contract  
3 hours ago



**C++/Matlab Electronics/Sof...**

£200 - £300 per Day  
Oxfordshire  
Contract  
7 minutes ago



**Senior Java Developer - Eli...**

£100k per annum + Up to 100% B...  
City Of London  
Permanent  
4 days ago

**Web and IT REPORTING AN...**

£30k - £40k per annum + Benefits  
City Of London  
Permanent  
7 days ago

**Quantitative Analyst - Hedge...**

£70k to £150k per annum + Benefi...  
London  
Permanent  
2 days ago

**Senior Integration/Softwar...**

85k Per Annum  
London  
Permanent  
6 days ago

**Principal Software Engine...**

£40k - £50k per annum  
Derby, Derbyshire  
Permanent  
1 day ago

**Equities Quant - Quantitativ...**

To £85k + Bonus + Bens  
London  
Permanent

**Quantitative Analyst - Hedge Fund in London £70k+**

London - £70k to £150k per annum + Benefits: Extra Benefits  
Permanent



Posted: Tuesday, 28 August 2012

Key Words: QUANT/QUANTITATIVE/ANALYST/SOFTWARE/C++/FINANCIAL/HEDGE FUND/MATLAB/SQL/LONDON/FORTRAN/MATHEMATICA/MATHS/MATHEMATICS/MATHEMATICAL




Exceedingly strong academics are required for this excellent Quantitative Analyst opportunity with a prominent Hedge Fund in Central London. As the ideal Quant, you will be educated to a Masters or PhD level in Mathematics, Statistics, Computer Science or Engineering from a top-tier red brick institution or international equivalent.

You will have a high proficiency working with programming languages, a fundamental part of this role. Experience with C++, Java or a further object-orientated programming language would be preferred, but experience with a mathematical language would also be beneficial, such as Matlab, Fortran or Mathematica or any exposure to quantitative methods.

You will look to combine your technical prowess with your strong mathematical and quantitative abilities, teaming it with a fantastic work ethos and a permanent drive to succeed. Ideally you will be passionate about finance and working in this industry.

This fantastic opportunity gives you the ability to earn a generous salary, start your career working for a company where you will be challenged daily and pushed to achieve your full potential. Interviews have begun for 2012 starts; apply now to avoid missing out.

<b>Location</b>	London, UK
<b>Industry</b>	<a href="#">IT</a>
<b>Rate</b>	£70k to £150k per annum + Benefits: Extra Benefits
<b>Employment Agency</b>	<a href="#">Oho Group Ltd</a> 
<b>Contact</b>	Kain Craigs 
<b>Email</b>	<a href="#">Contact This Employment Agency</a>
<b>Web Link</b>	<a href="http://www.oho.co.uk">http://www.oho.co.uk</a>
<b>Reference</b>	JSKCLPXX111
<b>Posted Date</b>	28/08/2012 15:59:54
<b>Permalink</b>	<a href="http://www.jobserve.com/C1Kji">http://www.jobserve.com/C1Kji</a>



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[Learning Zone](#)

# Darbų susiskirstymas

- Developer – programuotojai
  - Programuoja sistemas
- Research analyst – quant – analitikai
  - Analizuoja duomenis
  - Kuria ir testuoja modelius/sistemas
- Trader/strategist – prekiautojai
  - Prekiauja biržoje, stebi rinkas, generuoja idėjas prekybos sistemoms

# Quants

- Kuom užsiima analitikai – “Quants”
  - Algoritminių sistemų analizė
  - Modelių kūrimas
  - Išvestinių instrumentų kūrimas “Pricing”
  - Rizikos vertinimas

### **CVA Quantitative Analyst**

£600 - £700 per Day

City Of London

Contract

*2 days ago*

### **C++ Quantitative Developer**

£600 - £700 per Day

City Of London

Contract

*3 days ago*

### **C#/F# Developer - Hedge Fu...**

£60k - £100k per annum + Benefits

City Of London

Permanent

*10 hours ago*

### **C# WPF Developer Propriet...**

£75k + bonus + benefits

City, London

Permanent

*6 days ago*

### **C# Analyst Programmer - ...**

£500.00 - £600.00 per Day

City Of London

Contract

*7 days ago*

### **1yr Contract - Quantitative ...**

£400-£1000 per day

London

Contract

*12 hours ago*

### **C# WPF Developer Propriet...**

£75k + bonus + benefits

City, London

Permanent

*6 days ago*

# Programavimas algoprekyboje

- Komunikavimas su birža ar brokeriu
- Spartus rinkos duomenų apdorojimas
- Maksimalus “koru” išnaudojimas
- Spinlockai ir lock free programavimas
- Labai spartus apsikeitimas duomenimis
- Complex event processing
- High performance, GRID
- Ir žinoma GUI, reportai, webas



# Kokio tipo sistemos

- Pagrindinės algoritminės prekybos sistemos
  - Fundamentinės
  - Dažna prekyba/rinkos kūrimas (HFT)
  - Trendų sekimas
  - Arbitražas
  - Prieštrendinės
  - ...

# Kurso kryptis

- Kam labiau tinka programavimas
  - Daugiau programavimo
  
- Kam sunkiau su programavimu
  - Daugiau analizės
  - Excel panaudojimas

# Pratybos

- Naudosim MATLAB
- Analizuosim rinkos duomenis, braižysim grafikus, juos analizuosime
- Rašysime primityvias prekybos strategijas, testuosim jas simuliacijoje
- Prisijungsime prie brokeriu API, siuntinesime sandorius, analizuosime rinkos duomenis
- Nagrinesime egzistuojančias prekybines sistemas

# Literatūra

- Ernie Chan. Algorithmic Trading: Winning Strategies and Their Rationale
- Trading and Exchanges: Market Microstructure for Practitioners by Larry Harris
- Inside the Black Box: The Simple Truth About Quantitative Trading by Rishi K Narang
- New Trading Systems and Methods by Perry J. Kaufman
- Options, Futures & Other Derivatives by JOHN C HULL

# Kiti resursai

- Brokeris Interactive Brokers - [www.interactivebrokers.com](http://www.interactivebrokers.com)  
TWS (edemo/fdemo demouser)
- Nemokama sistema valiutomis - [www.metaquotes.net](http://www.metaquotes.net)
- Investavimo enciklopedija – [www.investopedia.com](http://www.investopedia.com)
- *FIX* protokolas – [www.fixprotocol.org](http://www.fixprotocol.org)
- *finance.yahoo.com* – nemokami rinkos duomenys
- <http://code.google.com/apis/finance/>

# Kokie namų darbai

- Duomenų nuskaitymas, indikatorių programavimas ir pašymas grafiškai MATLAB aplinkoje
- Prekybinės sistemos simuliacijos parašymas MATLAB kalba ir optimizavimas, rezultatų rodymas
- Portfelio kūrimas, optimizavimas
- Prisijungimas prie IB API, duomenų parodymas, sandorių nusiuntimas

# Balų sistema

- 4 (egzamino testas)
- 4x1.5 (namų darbas)
- Namų darbo vėlavimas:
  - 1 sav. –25%, 2 sav. -50%, >2 sav. –100%
  - Jeigu negalit pristatyti namų darbą siusti e-paštu (tik spec atveju)
- 0.5 balas - paskaitų lankomumas ne prastesnis negu 75%
- 0.5 balas – sviri pagalba tobulinant paskaitų medžiagą

# Namų darbų tvarakaraštis

Paskaita 001				
Paskaita 002				ND1
Paskaita 003				ND1
Paskaita 004				ND1
Paskaita 005			ND2	
Paskaita 006			ND2	
Paskaita 007			ND2	
Paskaita 008		ND3		
Paskaita 009		ND3		
Paskaita 010		ND3		
Paskaita 011	ND4			
Paskaita 012	ND4			
Paskaita 013	ND4			
Paskaita 014				
Paskaita 015				
Paskaita 016				



# Namų darbas 1 (iš 4)

- Susipažinimas su rinkos duomenimis  
Studentas turėtų pademonstruoti kad supranta ir moka užkrauti duomenis į MATLAB aplinką ir juos atvaizduoti ir atlikti elementarias manipuliacijas su jais bei atvaizduoti rezultatus. Savarankiška duomenų paieška
- Pakrauti duomenis į MATLAB
  - Tikinius
  - Minutinius
  - Dieninius
- Atvaizduoti duomenis (visus tris)
- Atsitiktinių duomenų generavimas ir atvaizdavimas  
Papildomai kelis (10-ukui):
- Sudaryti sesijas iš minutinių, tikiniu duomenų
- Sujungti ateities sandorių duomenis į vieną eilutę
- Dviejų skirtingų (akcijos ir forex) laiko eilučių suliginimas papildant tuščias dienas arba jas ištrinant (pvz: sukonvertuoti JAV akcijos kainas į EUR).
- Surasti 10 didžiausių pertraukų duomenyse ir jas atspausdinti (kokio ilgio kada buvo)
- Iš tikinių duomenų suformuoti valandinius barus arba minutinius

Pabaiga

# TWS

- Žaidimas kas daugiau uždirbs prekiaudamas tas gaus 1 bala prie pirmo namų darbo 😊
- Įvesti naują simbolį
  - Akcija, valiuta, ateities sandoris
  - Įvesti market ir limit sandorį (kaina, galiojimas, pusė, uždaryti)
  - Atšaukti (Cancel) sandorį
- Sukurti grafiką
  - Pakeisti grafiko dažnumą, įdėti indikatorius
- Account langas,
- Trade log langas

# MATLAB

- Parodyti pvz. ir prasyti pakeisti truputi
- Pabandyti MATLAB
  - Susikonfiguruoti
  - Įvesti pvz. ir jį paleisti
  - Įkelti duomenis iš failo ir parodyti
  - Pagrindinė sintakse
  - Masyvai, cell masyvai
  - Masyvu operacijos
  - Spausdinti ant ekrano
  - struktūros

# Tradestation DEMO

- Chart
- Market depth
- Strategy
- Indicator