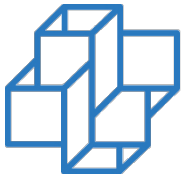
III Workshop da Escola de Informática & Computação (WEIC)

Ciência para o Esporte

Fabio Porto

fporto@lncc.br

Laboratório Nacional de Computação Científica



DEXL LAB

EXTREME DATA LAB

Agenda

- LNCC - MCTI
- Qual o papel da ciência do Esporte?
- Ciência baseada em dados
- SAHA – Sistema de Apoio Holistico a Atletas
- Comentários finais

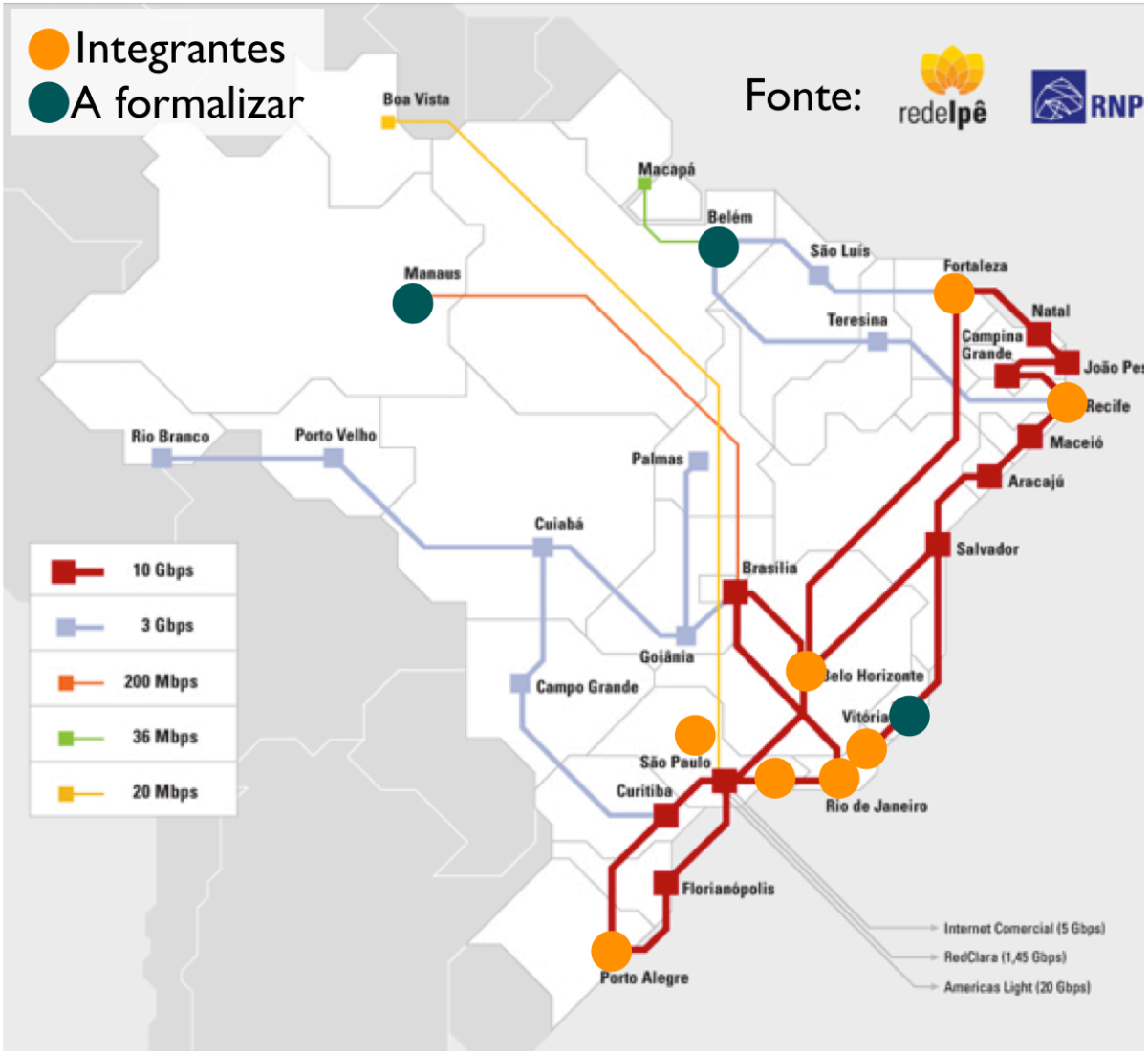
Laboratório Nacional de Computação Científica (LNCC)

Petropolis, Rio de Janeiro

SINAPAD – Sistema Nacional de Alto Processamento

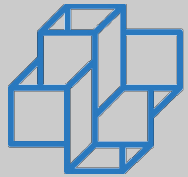
Organizado em CENAPADS:

- Universidades
- Centros de Pesquisa
- Diferentes Arquiteturas:
  - Discos Compartilhados
  - Memória Compartilhadas
  - CPU/ GPUs



Atos-BULL Supercomputer

SANTOS DUMONT CONFIGURATION



Machine Partition	Blades	CPU Processors/ Blade	CPU Cores/ processor	Total Cores CPU
B710 CPU's	504	2	12	12.096
B715+GPU	396	1	12	4.752
B715+PHI	108	1	12	1.296
B710+B715 CPU's	1008		12	18.144
B710cp +B715cpuPhi	612		12	13.392
MESCLA node			16	250
GPU/PHI	3,7			
	Blades	GPU Processors/ Blade	GPU Cores/ processor	Total Cores GPU
				or PHI
NVIDIA K40	396	1	2880	1.140.480
INTEL 7120X	108	1	61	6.588

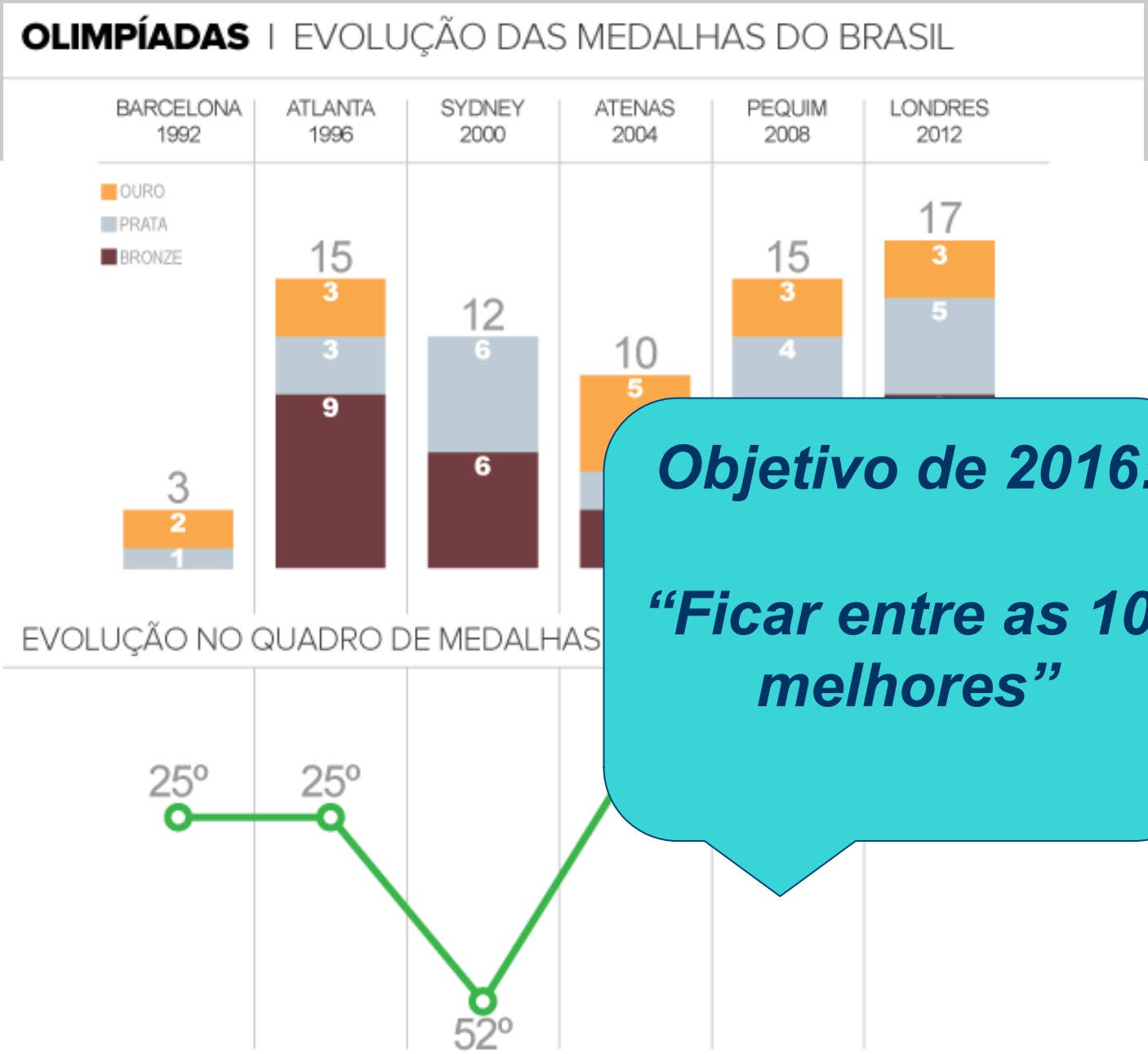
QUAL O PAPEL DA CIÊNCIA NO ESPORTE?

Esporte tem Ciência?

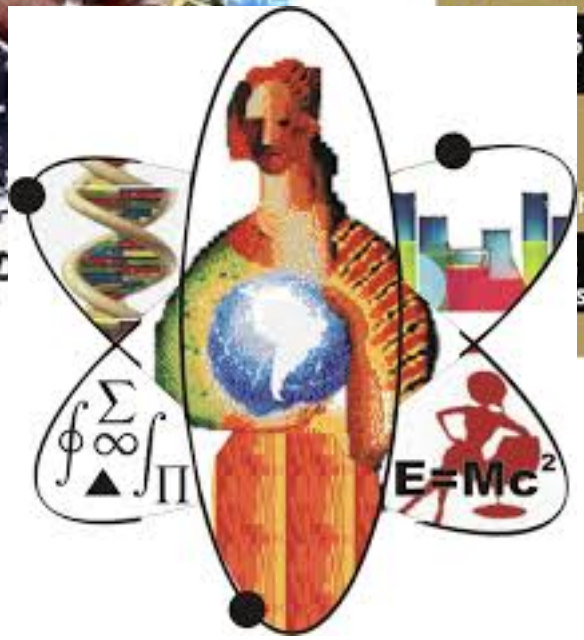
- Atletas de alto r… …alizam esporte de competição … …dalhas
- Resultado… …n: municípios, estados e n…
- Costuma-s… …esso em olímpiadas co… …a do país no cenário mundial

Como ele faz isso?

- Felipe França
  - Bateu record sul-americano (dele..)
  - Obteve índice para o mudial
  - Registrou o melhor tempo do ano
  - …..

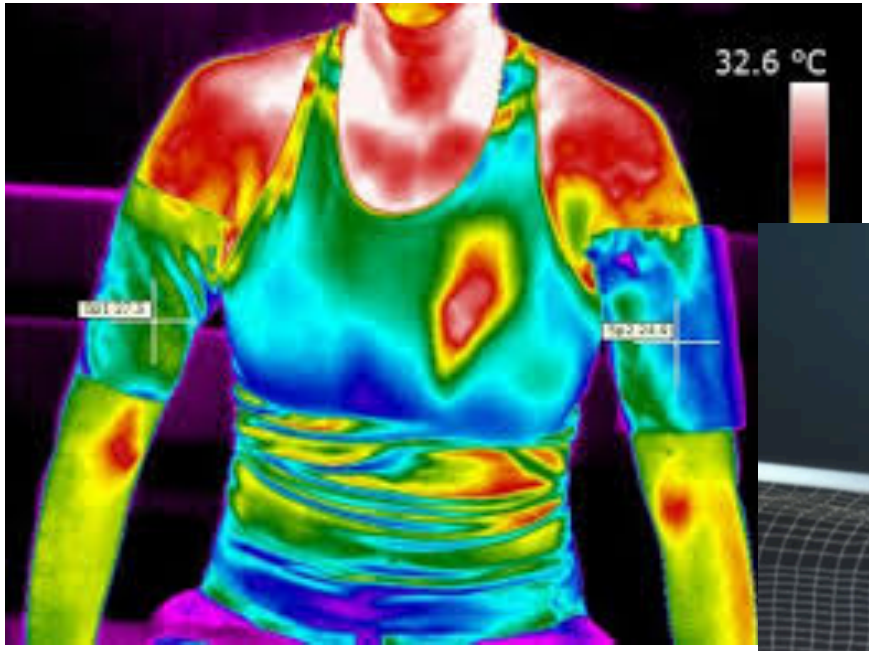

OLIMPÍADAS | EVOLUÇÃO DAS MEDALHAS DO BRASIL
BARCELONA 1992
ATLANTA 1996
SYDNEY 2000
ATENAS 2004
PEQUIM 2008
LONDRES 2012
OURO
PRATA
BRONZE
3
2
1
15
3
3
9
12
6
6
10
5
15
3
4
17
3
5
EVOLUÇÃO NO QUADRO DE MEDALHAS
25º
25º
52º
Objetivo de 2016:
"Ficar entre as 10 melhores"

Alternativas :



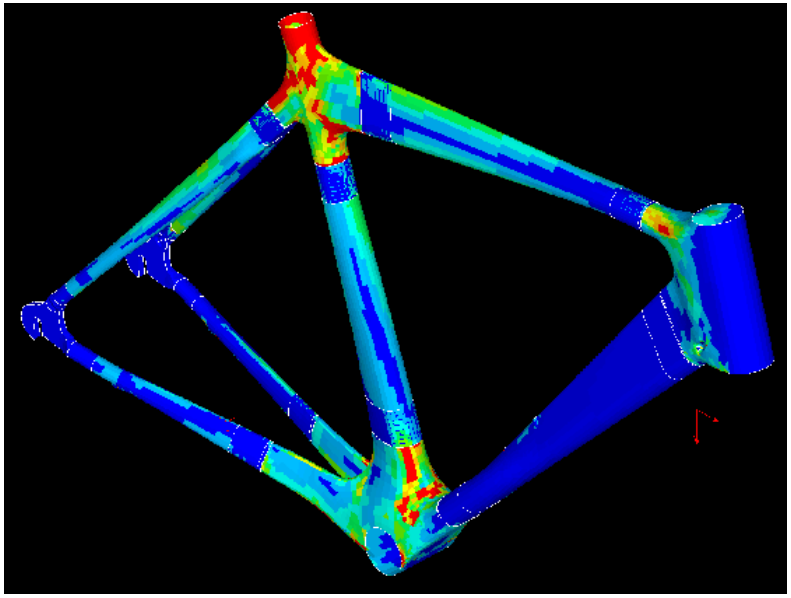
CIÊNCIA PARA O ESPORTE

O atleta e sua modalidade

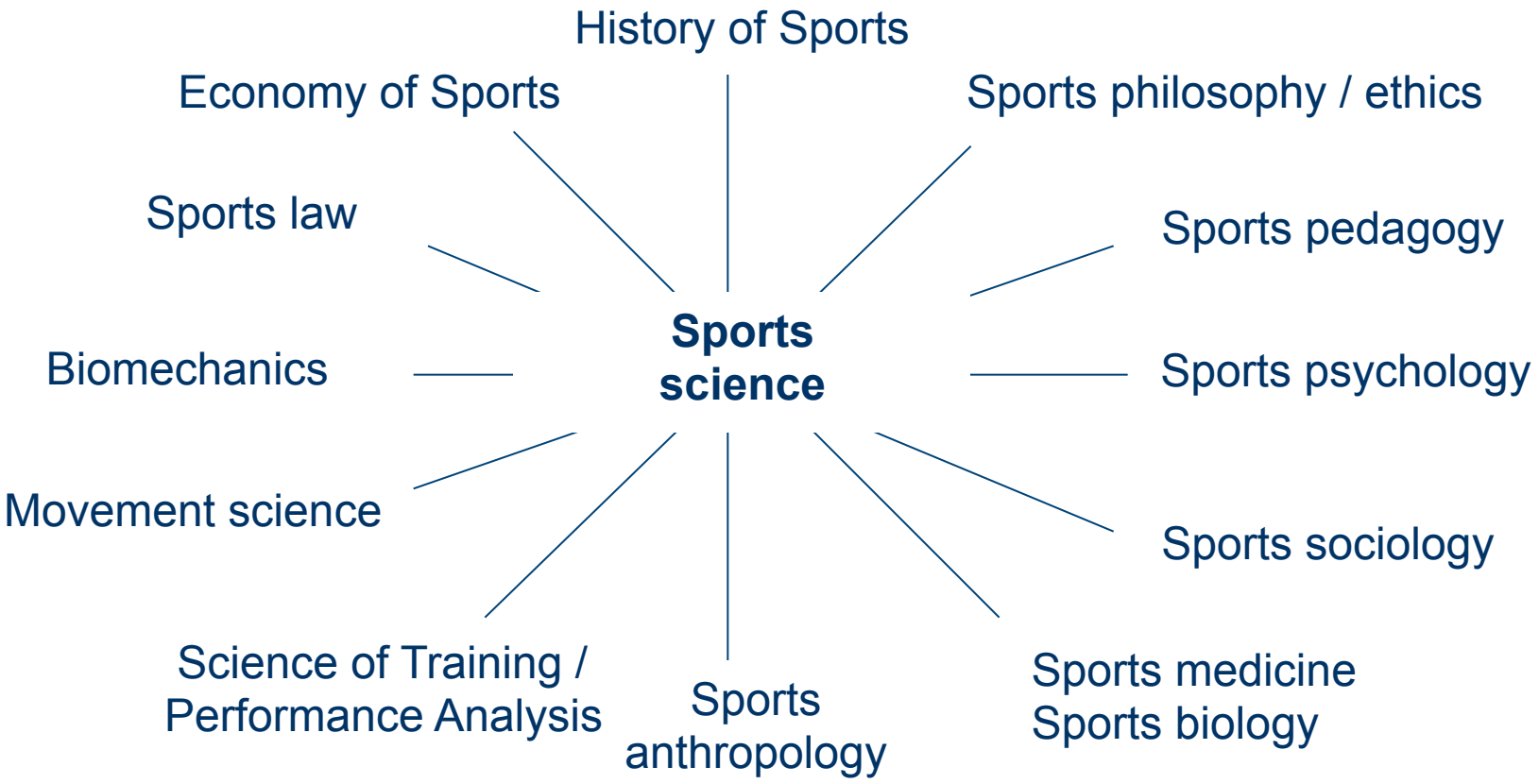


Modelos

- Simulação de movimento: dinâmica aero e de fluidos
- Simulação de treinamento substituindo tentativa e erro

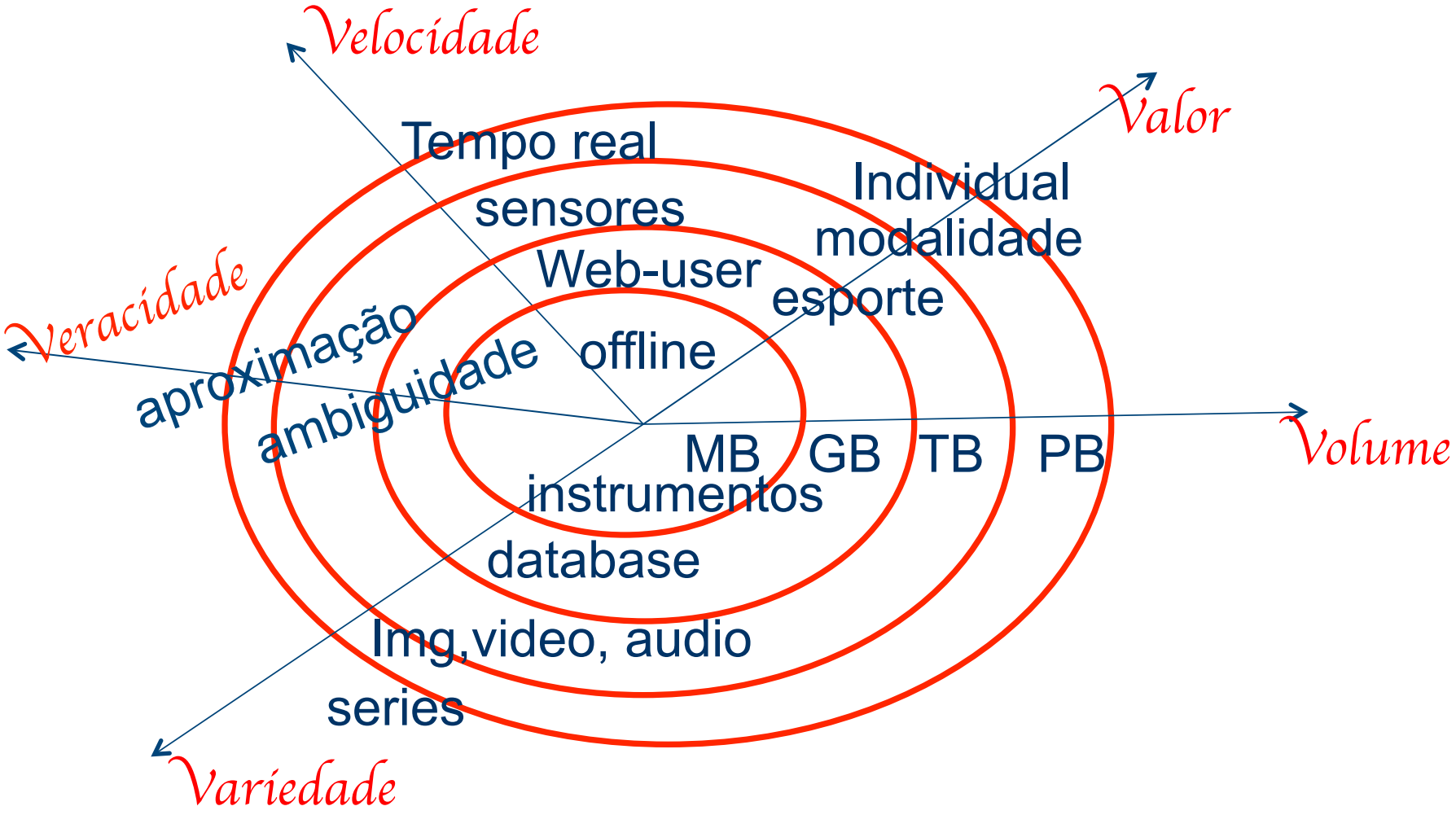


Áreas da Ciência do Esporte



CIÊNCIA BASEADA EM DADOS

Big Data – Tambem nos esportes

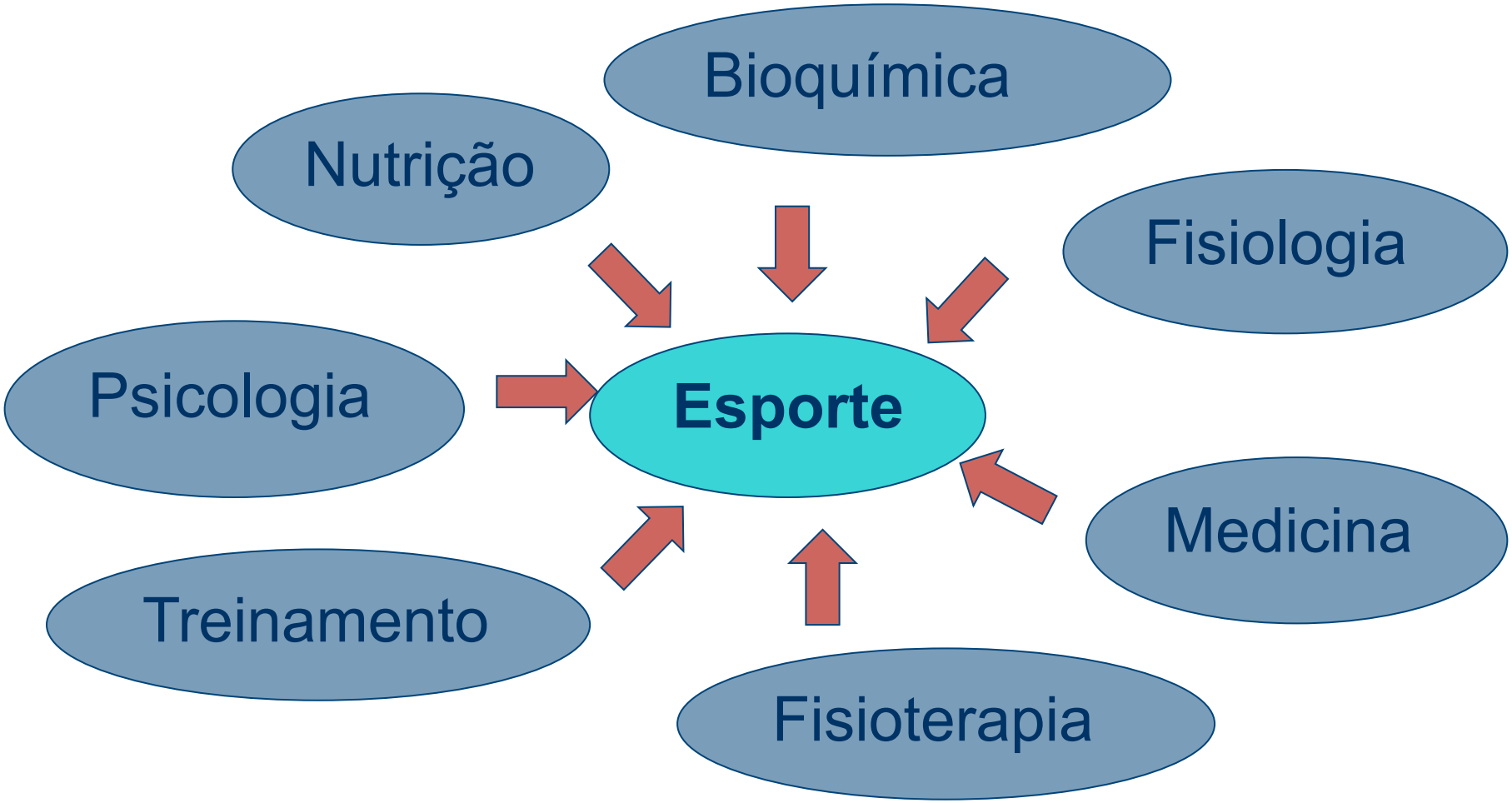


Big Data em Sportomics

- Reflete o dilúvio de dados produzidos no acompanhamento de atletas
- Input de diferentes disciplinas
- Uso de instrumentos para captura de dados

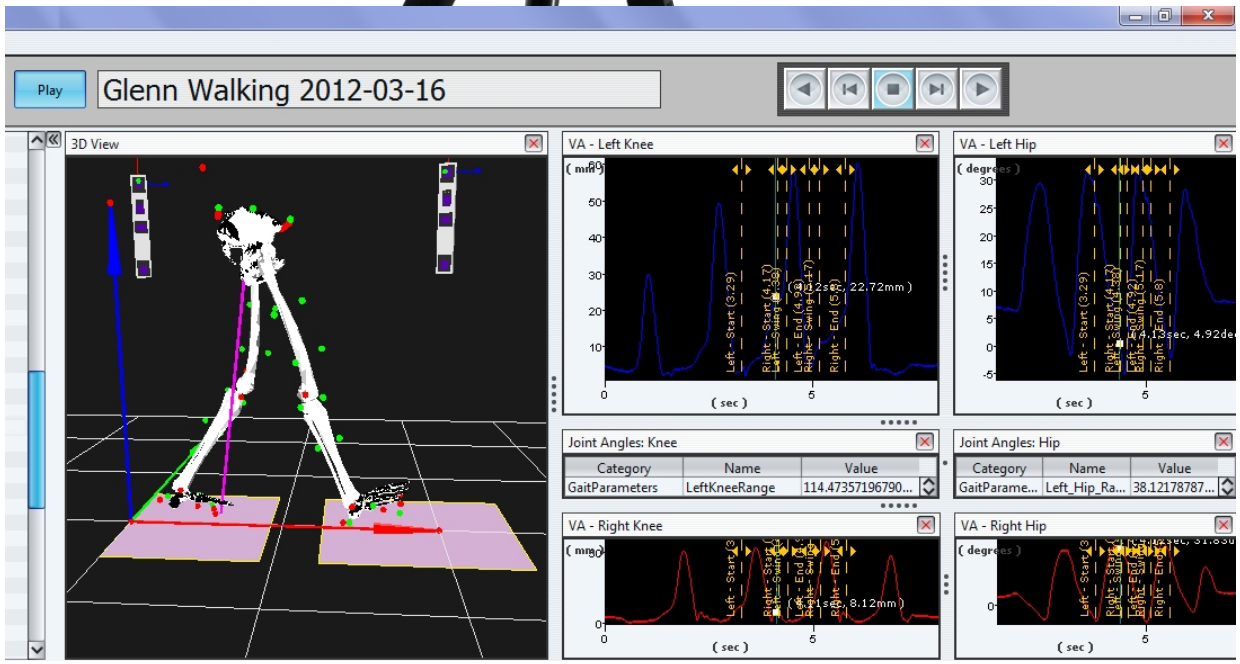
Cockpit para Sportomics

Ciência do Esporte Integrada



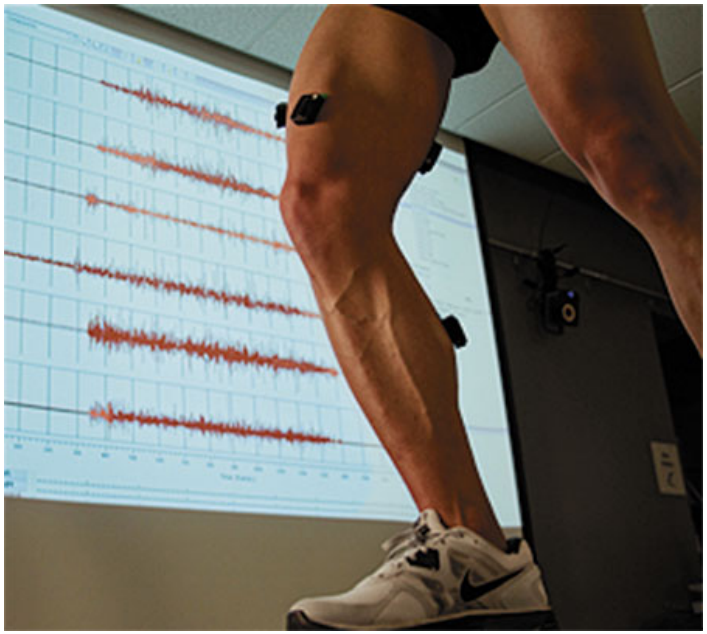
EM BIOMECÂNICA

codamotion

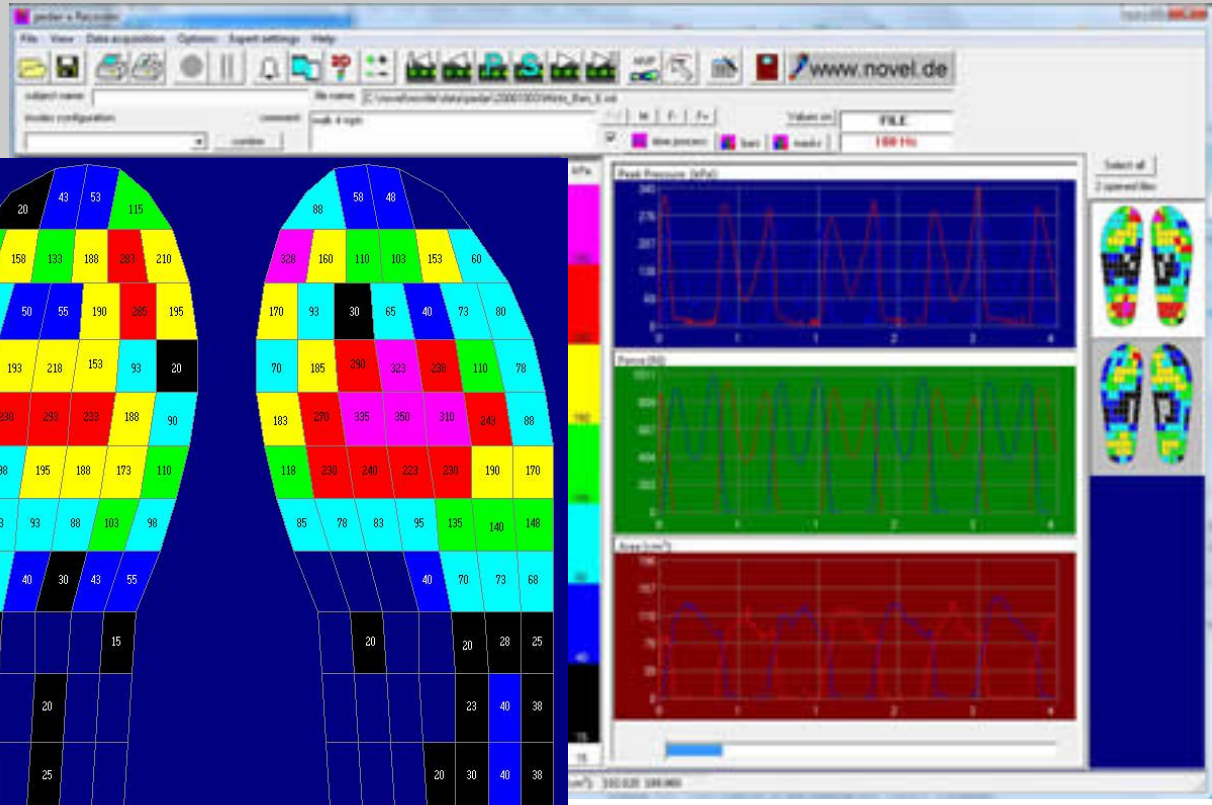

Play
Glenn Walking 2012-03-16
3D View
VA - Left Knee
VA - Left Hip
Joint Angles: Knee
Category
Name
Value
GaitParameters
LeftKneeRange
Joint Angles: Hip
VA - Right Knee
VA - Right Hip
(sec)

DELSYS®

WEARABLE SENSORS FOR MOVEMENT SCIENCES

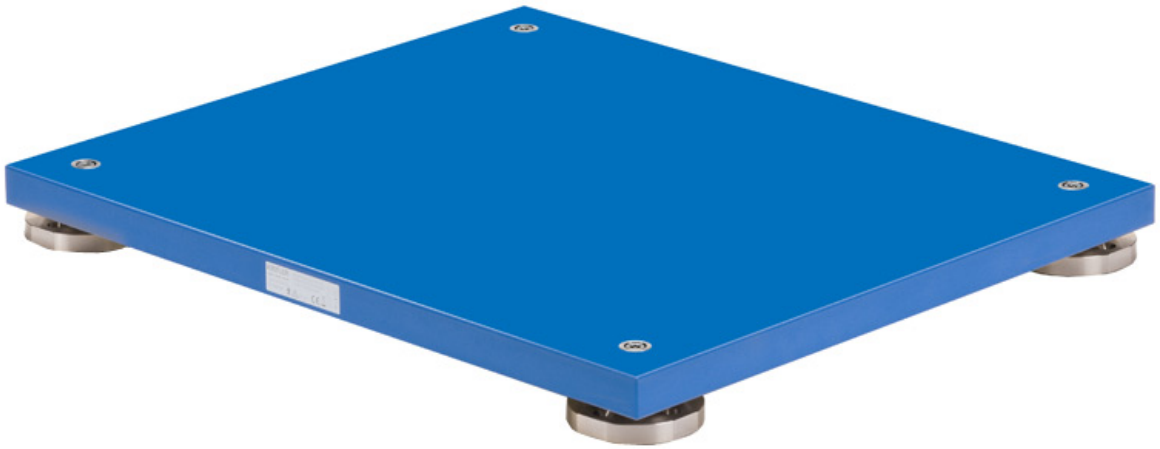


novel.de



KISTLER

measure. analyze. innovate.



NA BIOQUÍMICA

Extração de Sangue

Espectrometria de massa

De Dados Crus para Interpretação

cleaning

Integration

Transformation

Raw

Intermediary

Tailored

Tier:0

Tier:1

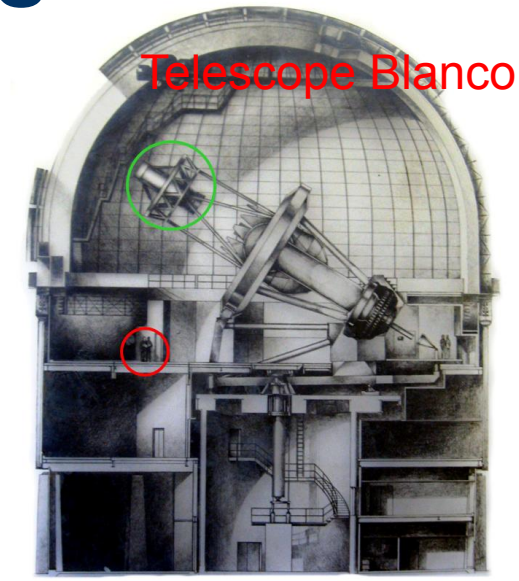
Tier:2

Como em outras ciências

LSST - Telescope

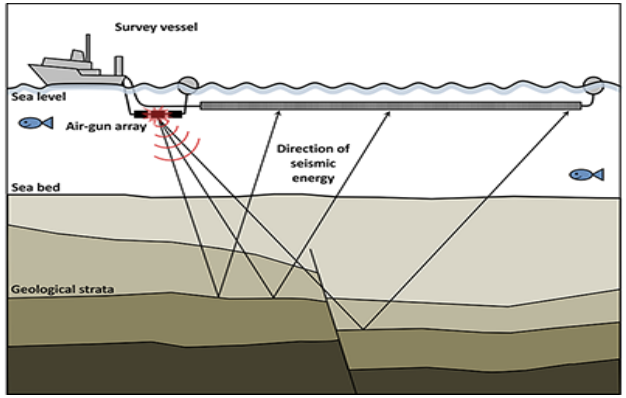
Illumina – HISeq2000

Telescope Blanco



Waters – Mass spectometry

Seismic Hydrophones

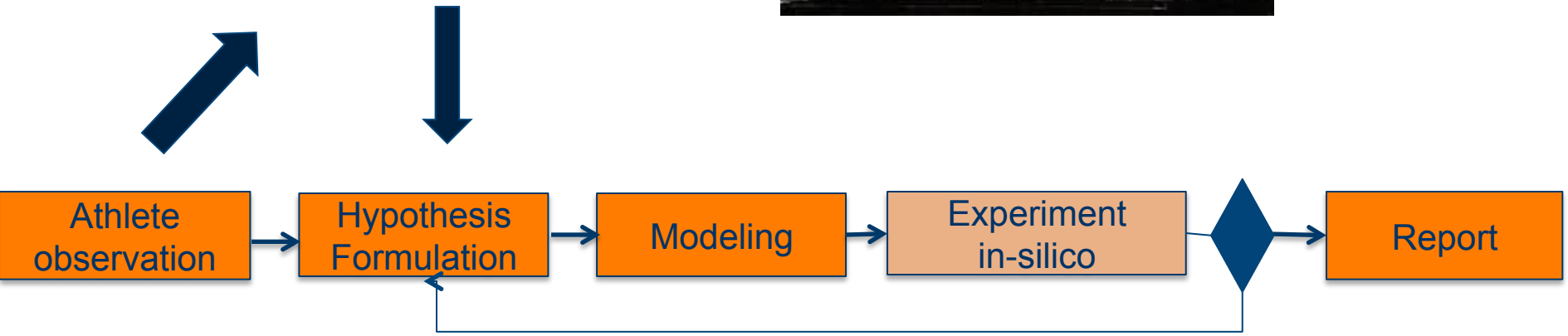


Mas…

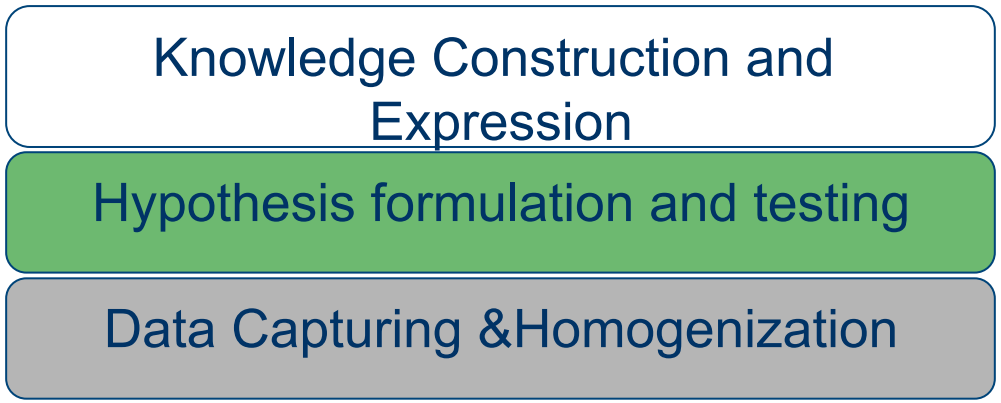
- "Scientists are spending most of their time manipulating, organizing, finding and moving data, instead of researching. And it's going to get worse"
  - Office Science of Data Management challenge - DoE

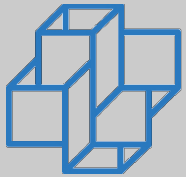
Topic of the decade

Ciclo de Vida da Ciência em Dados



De Big Data para Conhecimento



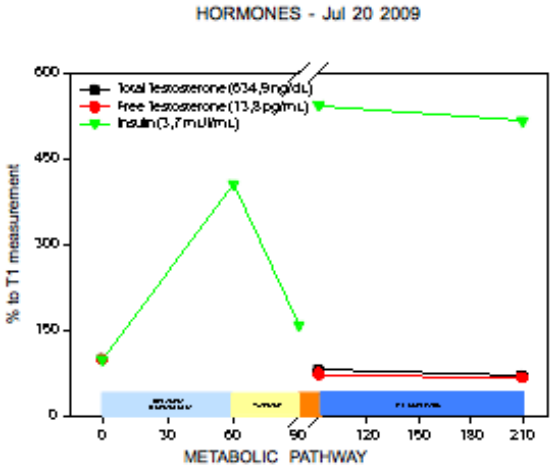


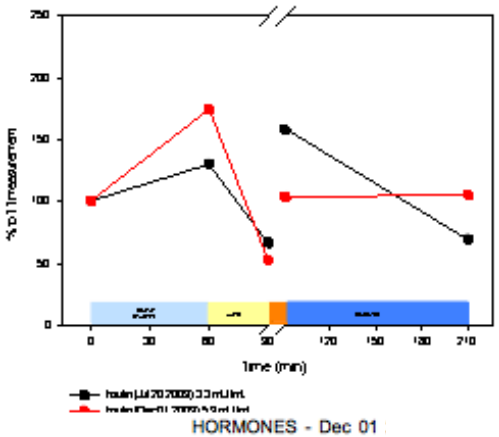
Exemplo

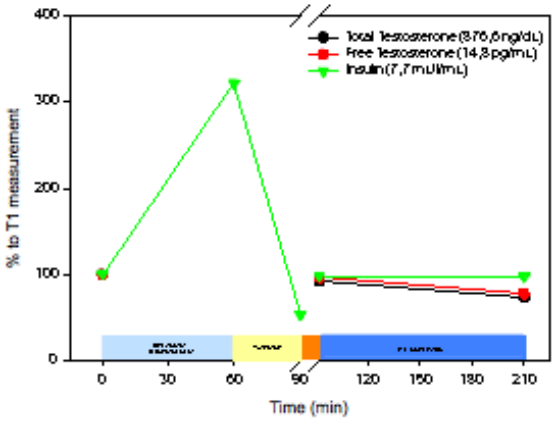
Dados de Bioquimica de equipes de futebol

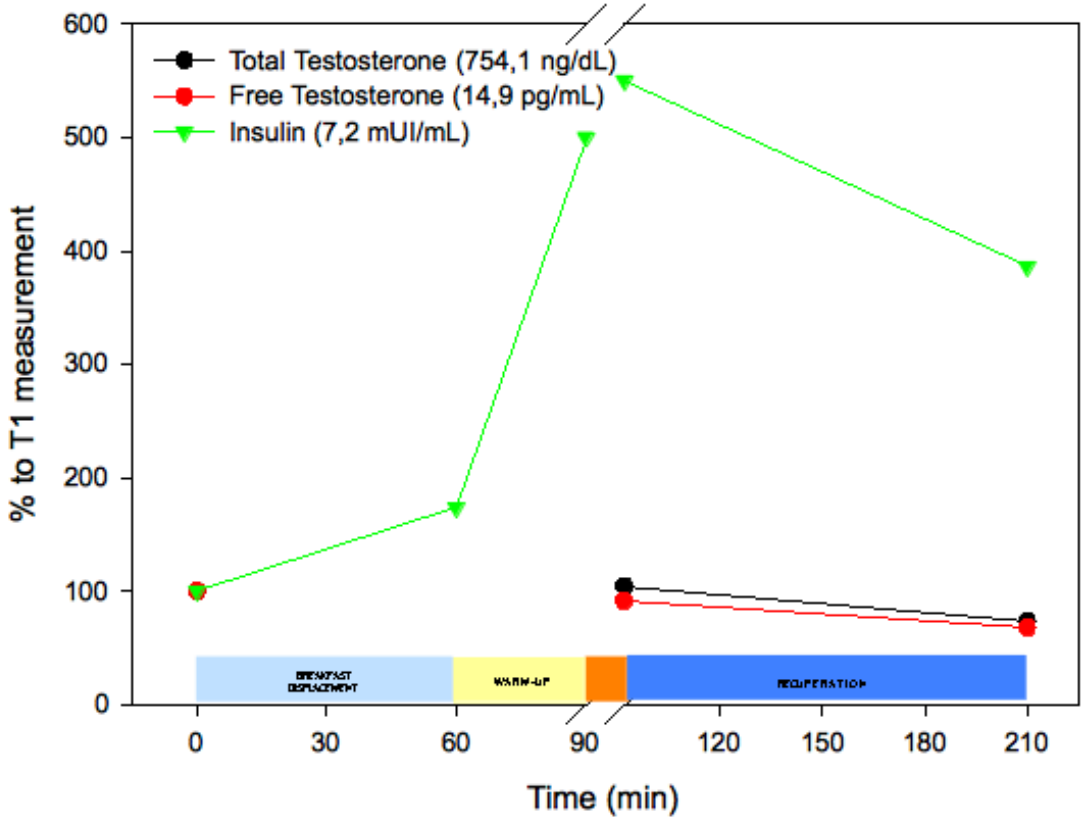
	POSIÇÃO	TIME	NOME	Metlyte 8										
			Unidade de medida	mmol/L					mmol/L					umol/L
			Analito	GLUCOSE					BUN					
				T1	T2	T3	T4	T5	T1	T2	T3	T4	T5	T1
N da bioquimica			Nomes	0	720	1080	2010	2075	0	720	1080	2010	2075	0
6	Volante	Laranja	Wilson Martins	6.5	5.8	6.6	9.3	8	4.4	4.5	5.3	5.8	6	108
16	Goleiro	Laranja	Bruno Rocha	5.4	6	4.4	7.8	7.3	5.5	4.7	4.3	5.3	5.1	105
29	Zagueiro	Laranja	Wendel Lomar da Cruz	5.3	5.6	5	8.2	5.5	4	3.3	3.5	4.3	4.5	121
2	Meia	Laranja	Jose Ricardo	6	7	4.5	6.9	6.1	4.9	4.4	4.9	5.8	5.9	113
8	Atacante	Laranja	Vitor Matheus	5.7	5.2	7	10	7.1	7	8.3	11.5	8.3	11.1	118
19	Lateral Esquerdo	Laranja	Jefferson Santos	5.1	5.3	4.8	12	11.3	6.4	5.5	6.9	6.5	7.1	75
7	Volante	Laranja	José Alexandre Marques Junior (Ramires)			3.9	9.6	6.6			4.2	4.7	5.2	
20	Meia	Laranja	Davi Cordeiro Miranda Ferraz			5.9	7	6			3.9	4.2	4.8	
27	Atacante	Laranja	Danilo Marioto			5.4	6	6.6			5.3	5.7	7.3	
25	Lateral	Laranja	Thiago Ennes			4.2	5.8	5.8			4.3	4.7	5.1	
26	Zagueiro	Laranja	Jobson Eduardo dos Santos	5	5.8	6.5	7.2	6.5	5.1	4.4	4.2	5	5.6	105
		Orange Time	Média	5.57	5.81	5.29	8.16	6.98	5.33	5.01	5.30	5.48	6.15	106.43
			SD	0.53	0.60	1.07	1.89	1.60	1.07	1.59	2.25	1.17	1.86	15.19
			SE											
28	Atacante	Grena	Carlos Alberto (Jacó)	5	5.4	4.7	7.9	8.3	5	4	3.8	4.4	4.8	90
1	Meia	Grena	Robson Rodrigo Costa	5.8	5.9	4.6	7	7.3	4.9	4.1	4.1	5.1	5.4	87
11	Atacante	Grena	Jefferson Gilbano	5.9	5.6	5.8	8	7	6.3	5	4.5	5	5.3	115
4	Goleiro	Grena	Lucas Henrique Geralderi		5.5	5.6	6.2	6.1		4.5	4.1	4.7	4.8	
24	Atacante	Grena	Alvaro Santos	4.9	6.9	9.5	5	7.2	4.8	4.4	4.7	4.4	4.7	111
3	Zagueiro	Grena	Matheus Junior do Nascimento	5.4	5.5	4.9	7.8	7.5	6.7	6.5	5.2	6.4	6.1	108
17	Zagueiro	Grena	Renato Barbosa Vischi	6.4	6.1	6.4	7.7	7.5	5.2	4	4.7	5.9	6.3	106
5	Meia	Grena	Luan Borges Machado	4.9	5.8	4.8	7.2		4.6	4.1	3.8	4.1		101
12	Volante	Grena	Walney Oliveira Vieira	5.3	5.4	4.8	6.8	6.3	4.9	4.7	4.7	5	5.5	135
23	Meia	Grena	Yuri			5.6	6.2				4.4	4.7		
9	Lateral	Grena	Eduardo M. C. de Queiroz (Dudu)			4.7	6	5.7			4.2	5.2	5.6	
14	Volante	Grena	Mauricio Moreira dos Santos			5.7	7.8				5.8	6		
22	Lateral	Grena	Sidnei B. da Fonseca Junior			7.2	6.1	6.1			4.7	4.9	5.1	

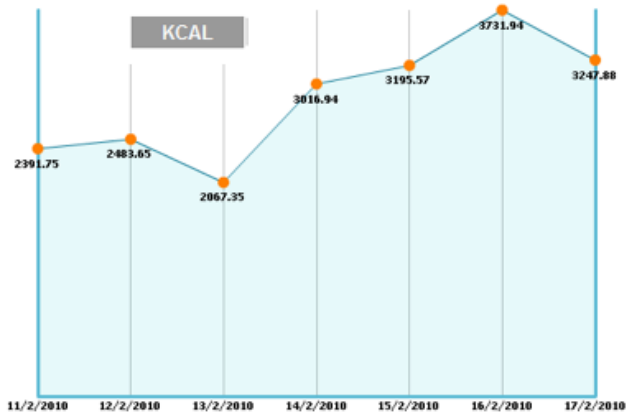
Results

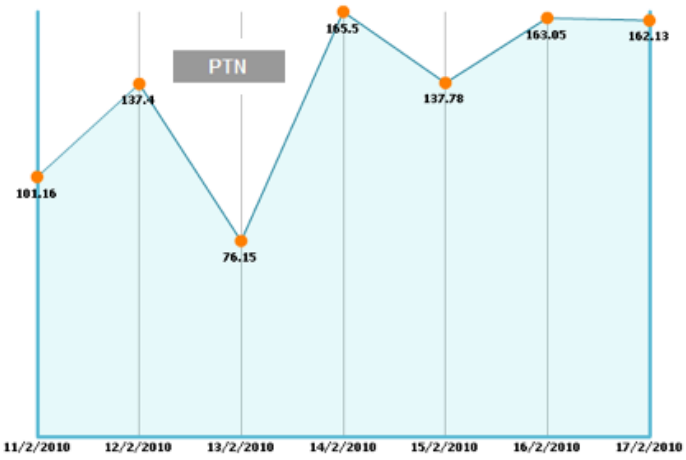

HORMONES - Jul 20 2009
Total Testosterone (634,9 ng/dL)
Free Testosterone (13,8 pg/mL)
Insulin (3,7 mUI/mL)
% to T1 measurement
METABOLIC PATHWAY

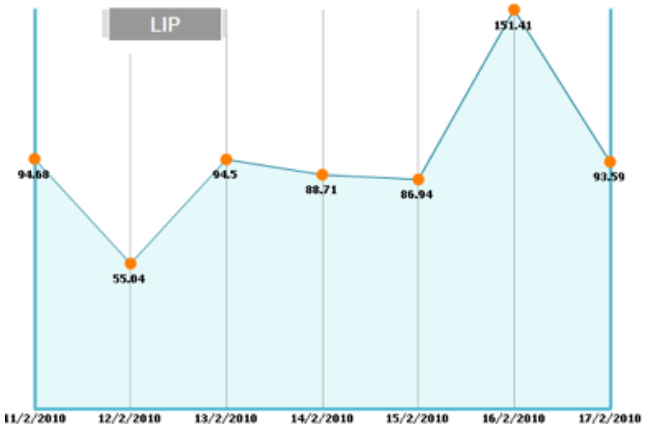

Time (min)
HORMONES - Dec 01

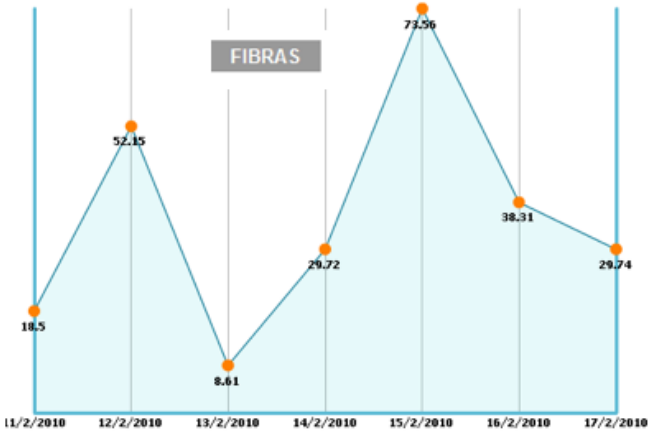

Total Testosterone (876,6 ng/dL)
Free Testosterone (14,8 pg/mL)
Insulin (7,7 mUI/mL)
% to T1 measurement
Time (min)


HORMONES - Dec 01
Total Testosterone (754,1 ng/dL)
Free Testosterone (14,9 pg/mL)
Insulin (7,2 mUI/mL)
% to T1 measurement
Time (min)

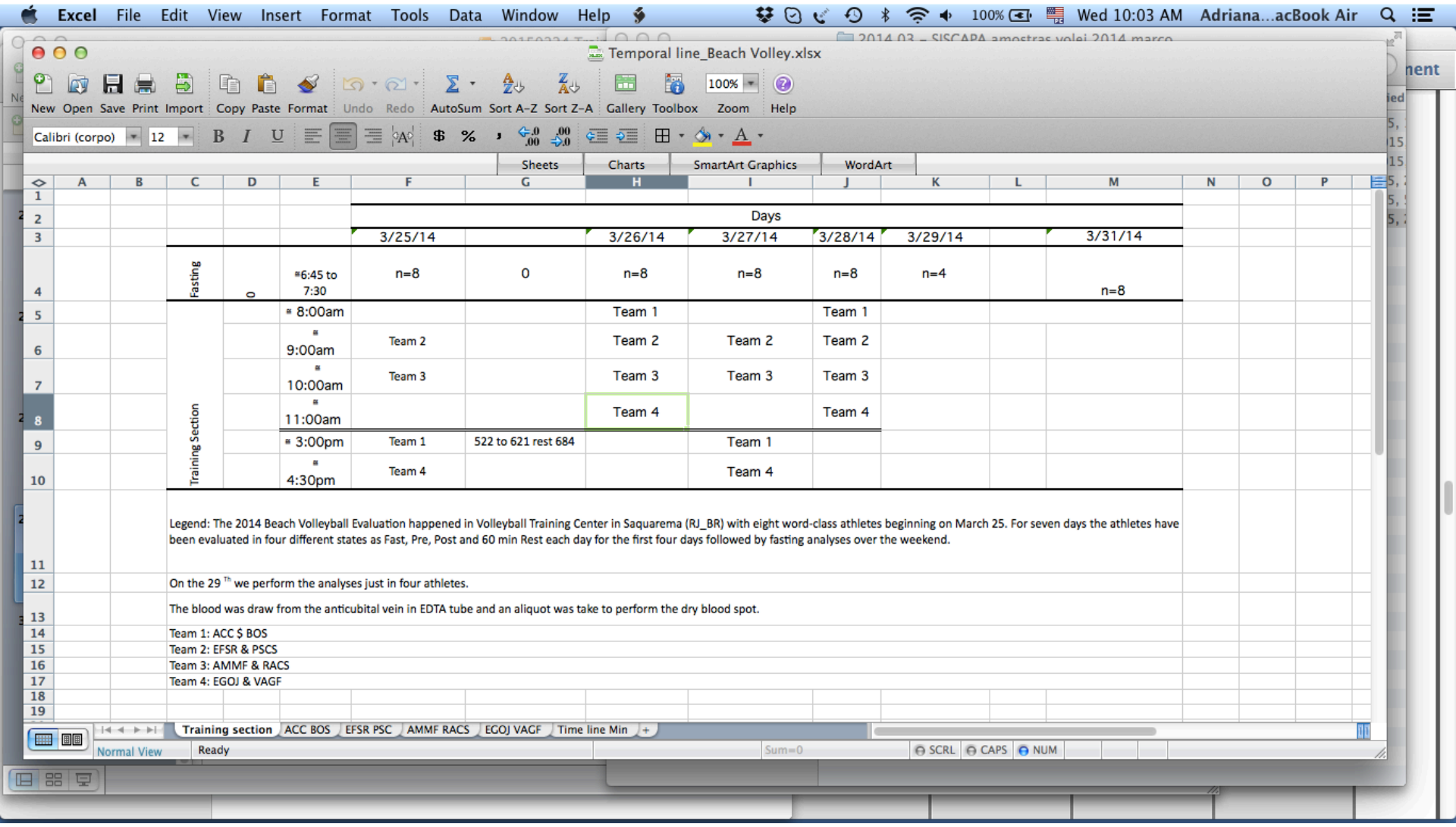

KCAL
2391.75
2483.65
2067.35
3016.94
3195.57
3731.94
3247.88
11/2/2010
12/2/2010
13/2/2010
14/2/2010
15/2/2010
16/2/2010
17/2/2010


PTN
101.16
137.4
76.15
165.5
137.78
163.05
162.13
11/2/2010
12/2/2010
13/2/2010
14/2/2010
15/2/2010
16/2/2010
17/2/2010


LIP
94.68
55.04
94.5
88.71
86.94
151.41
93.59
11/2/2010
12/2/2010
13/2/2010
14/2/2010
15/2/2010
16/2/2010
17/2/2010


FIBRAS
18.5
52.15
8.61
29.72
73.56
38.31
29.74
11/2/2010
12/2/2010
13/2/2010
14/2/2010
15/2/2010
16/2/2010
17/2/2010

Protocolo de Coleta de Dados



Temporal line_Beach Volley.xlsx

				Days						
			3/25/14		3/26/14	3/27/14	3/28/14	3/29/14		3/31/14
Fasting		6:45 to 7:30	n=8	0	n=8	n=8	n=8	n=4		n=8
Training Section		8:00am			Team 1		Team 1			
		9:00am	Team 2		Team 2	Team 2	Team 2			
		10:00am	Team 3		Team 3	Team 3	Team 3			
		11:00am			Team 4		Team 4			
		3:00pm	Team 1	522 to 621 rest 684		Team 1				
		4:30pm	Team 4			Team 4				

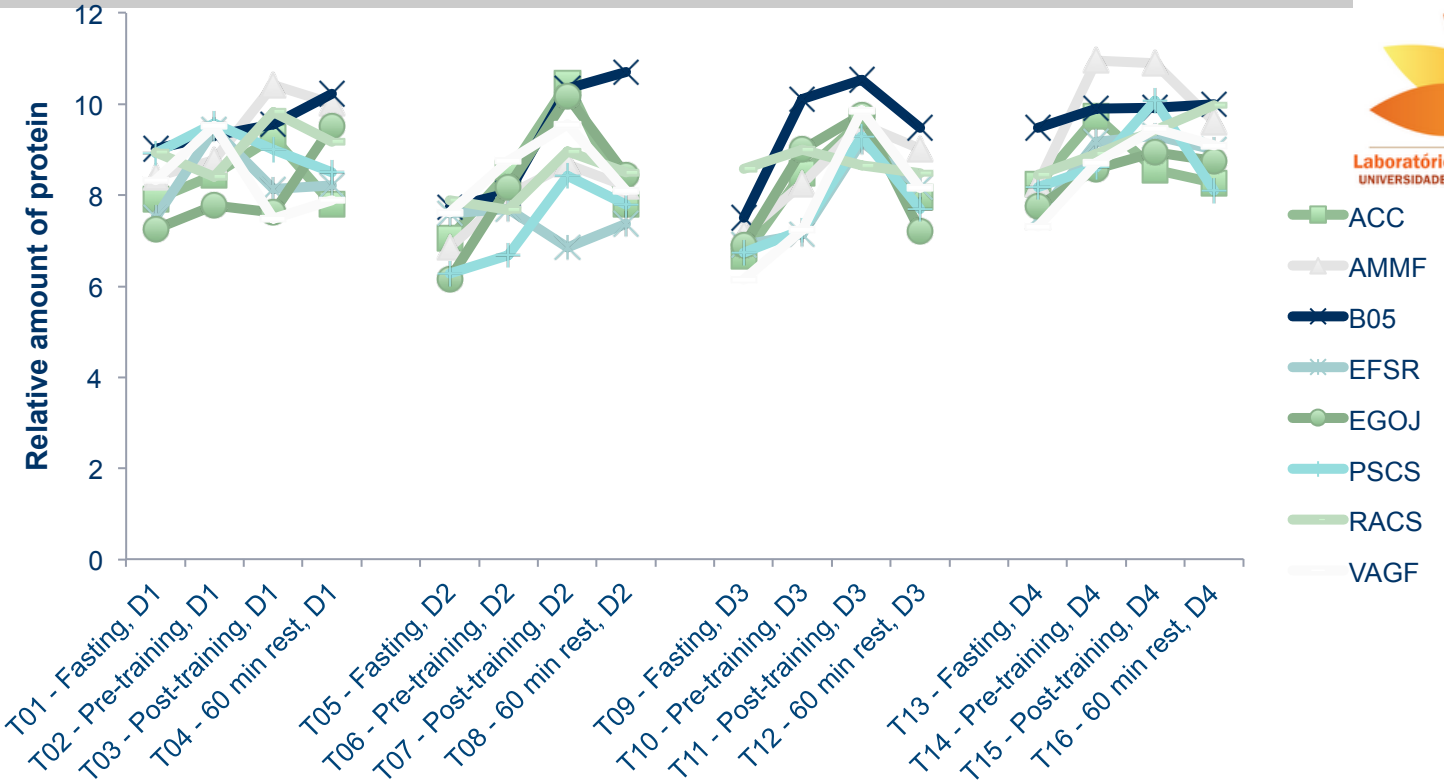
Legend: The 2014 Beach Volleyball Evaluation happened in Volleyball Training Center in Saquarema (RJ_BR) with eight word-class athletes beginning on March 25. For seven days the athletes have been evaluated in four different states as Fast, Pre, Post and 60 min Rest each day for the first four days followed by fasting analyses over the weekend.

On the 29 Th we perform the analyses just in four athletes.

The blood was draw from the anticubital vein in EDTA tube and an aliquot was take to perform the dry blood spot.

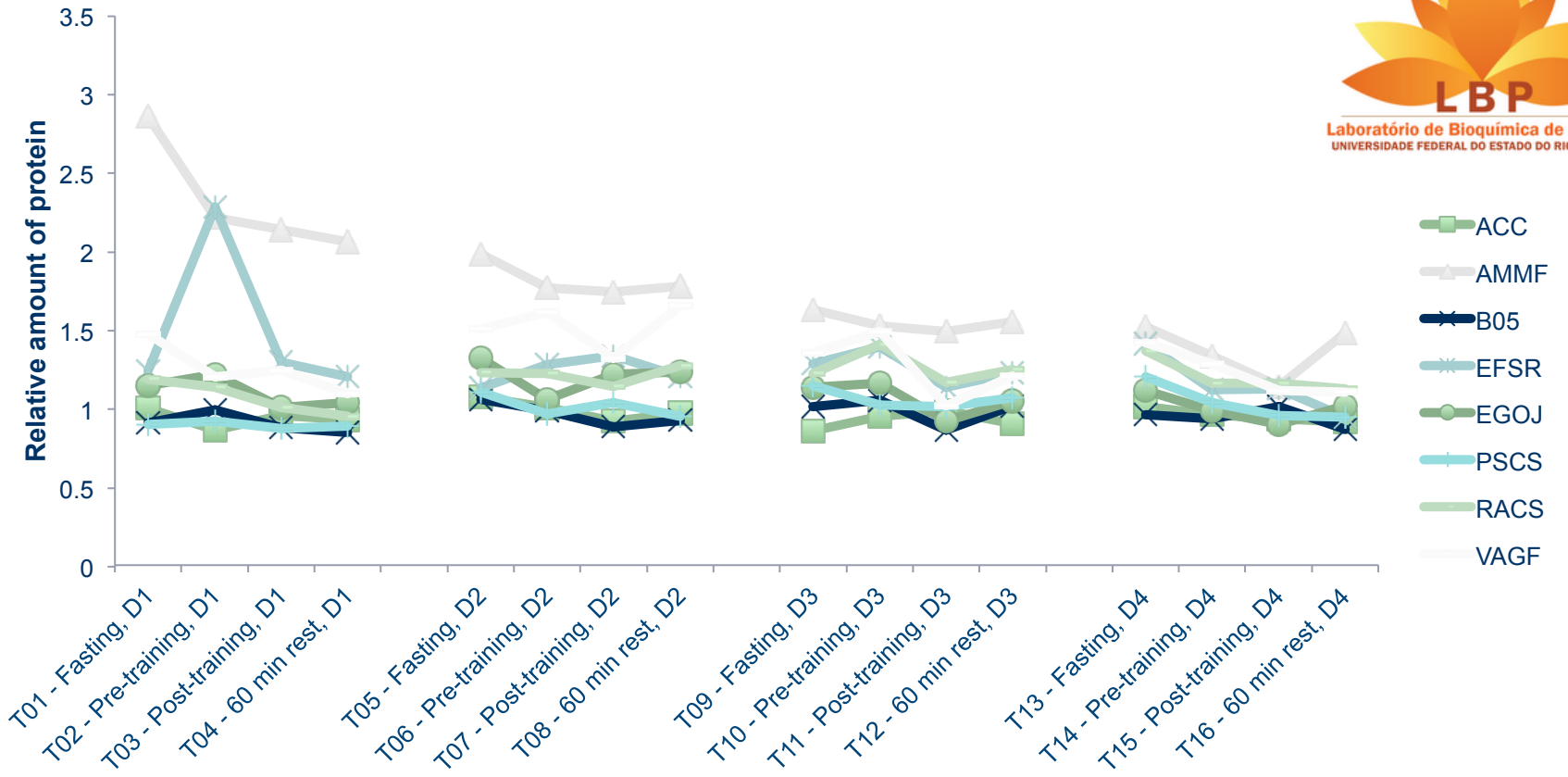
Team 1: ACC $ BOS
Team 2: EFSR & PSCS
Team 3: AMMF & RACS
Team 4: EGOJ & VAGF

Normalização baseada em Albumina



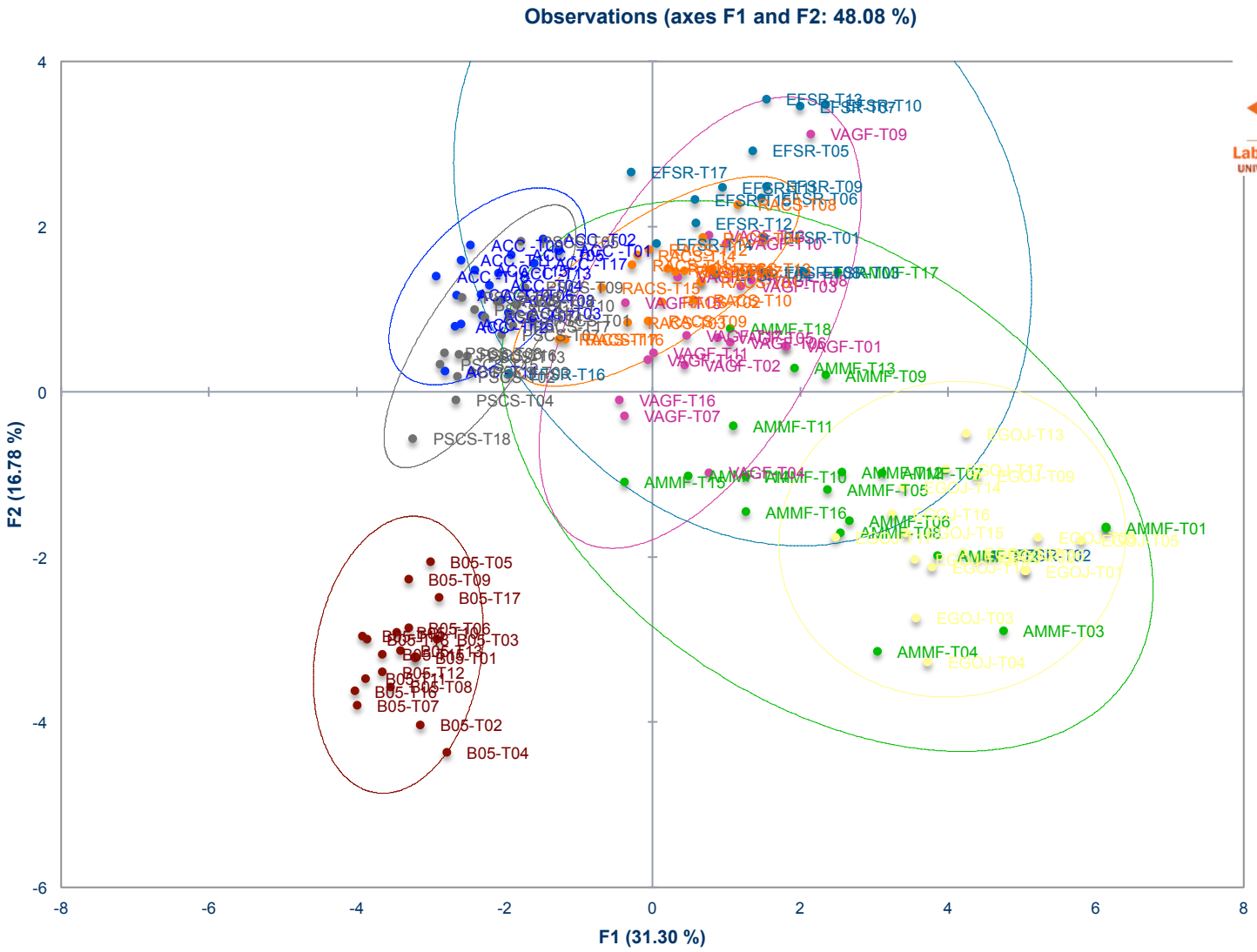
- Changes in albumin most likely reflect changes in total plasma protein concentration related to hydration
- Results for other proteins were therefore normalized using albumin (albumin assumed to be constant in each sample, and same for all individuals)

LPS-Binding Protein



LBP
Laboratório de Bioquímica de Proteínas
UNIVERSIDADE FEDERAL DO ESTADO DO RIO DE JANEIRO

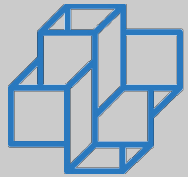
PCA: F1 *vs* F2



Laboratório de Bioquímica de Proteínas
UNIVERSIDADE FEDERAL DO ESTADO DO RIO DE JANEIRO

SAHA – SISTEMA DE APOIO HOLISTICO AO ATLETA

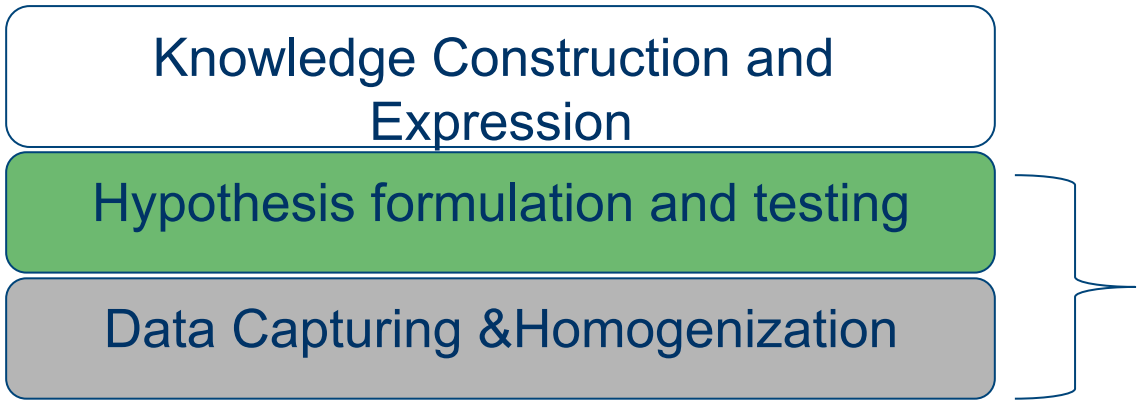
Objetivo Projeto SAHA



- Desenvolvido no Laboratório DEXL - LNCC
- Programa de pesquisa em Modelagem Computacional centrado no método científico em apoio à melhoria de desempenho dos atletas.
  - Meta
    - Desenvolver métodos, modelos e técnicas com foco na gerência e análise de dados produzidos pela pesquisa centrada no atleta

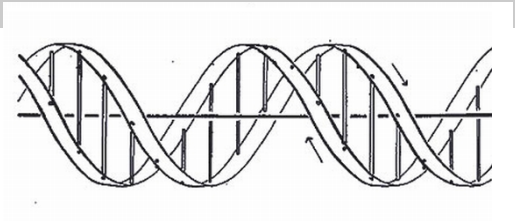
SAHA – Cockpit for e-Sports

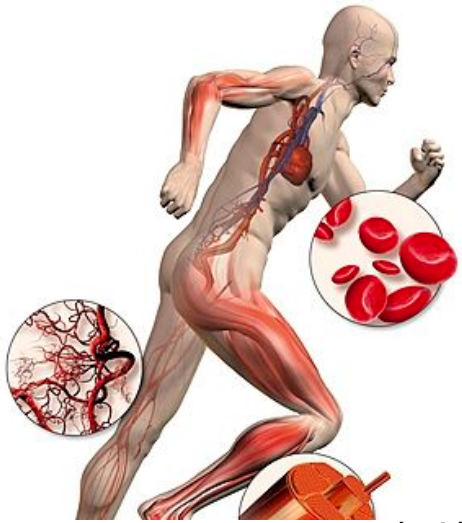
SAHA Role

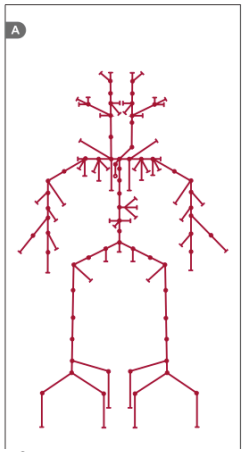

Knowledge Construction and Expression
Hypothesis formulation and testing
Data Capturing &Homogenization

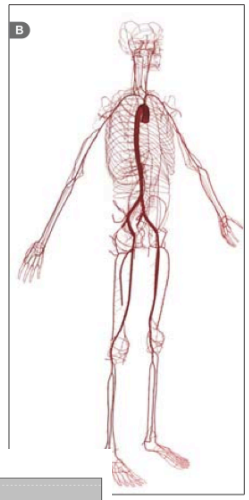
Do atleta

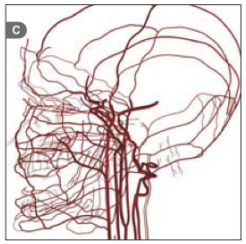
Ao e-Atleta

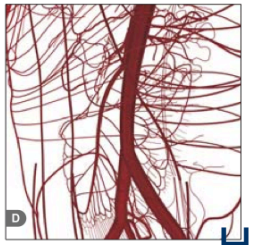




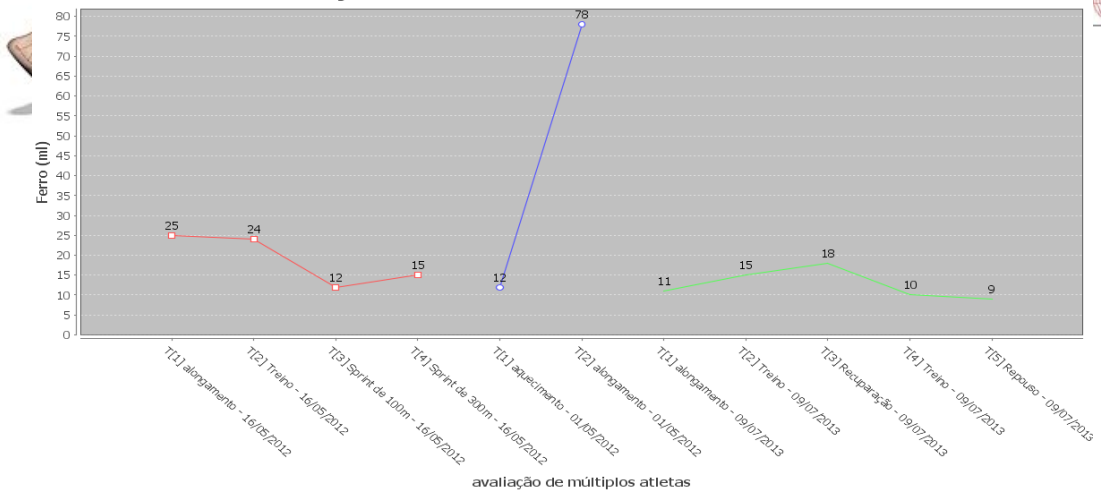






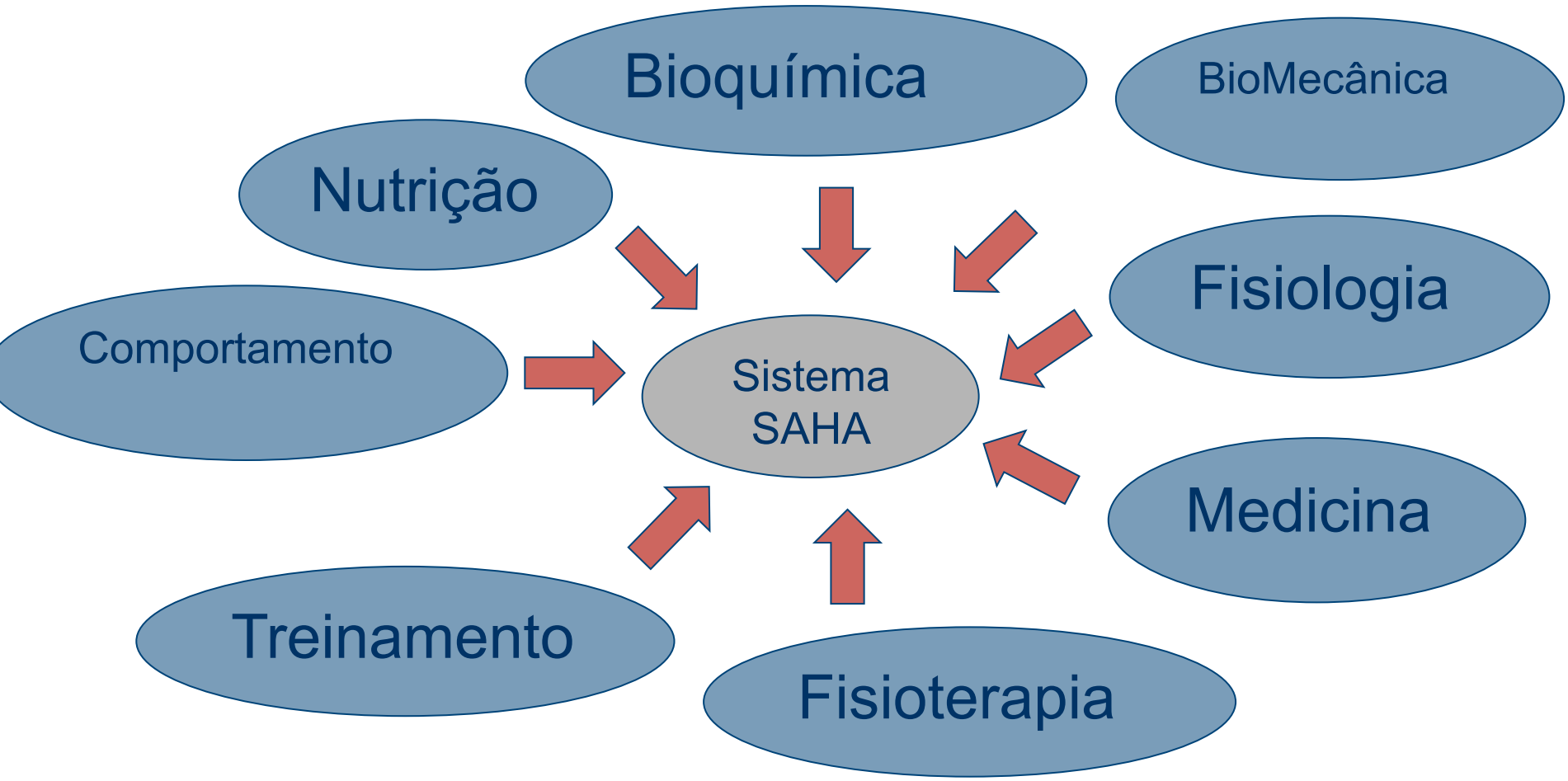


Trajetória básica de: 01/09/2010 à 27/09/2013

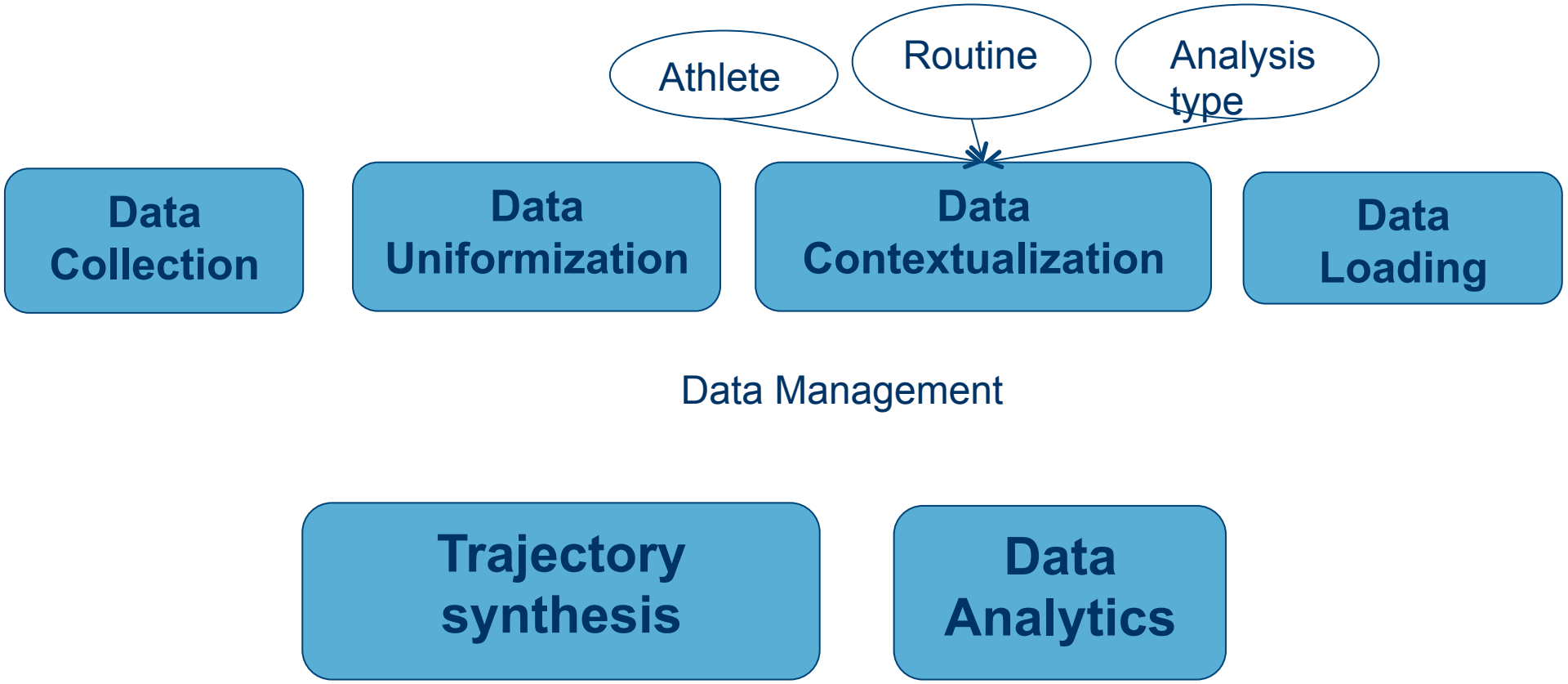


Hemolab

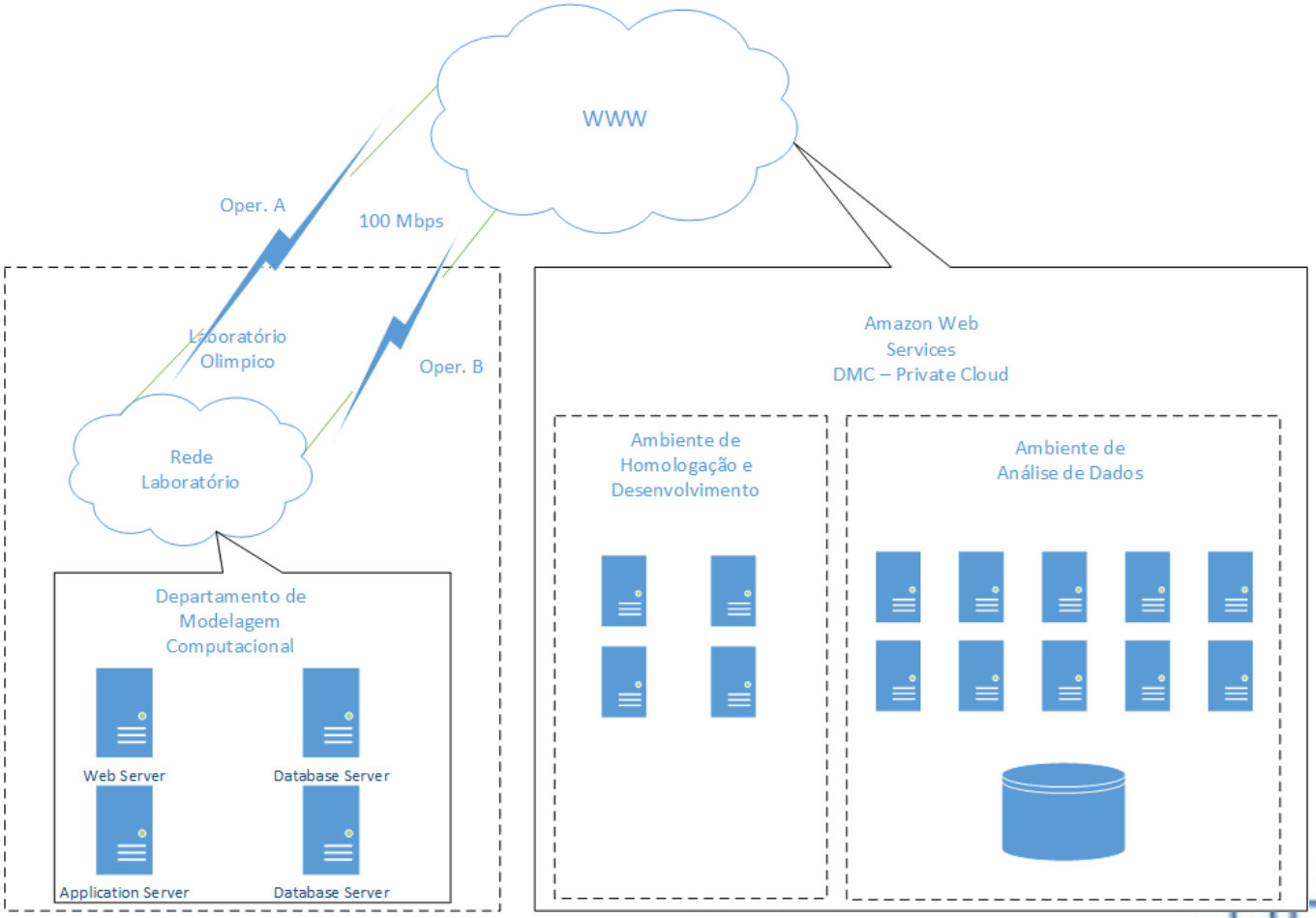
Ciência do Esporte Integrada



Modelo Abstrato



Arquitetura do Sistema



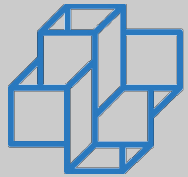
DEXL LAB
EXTREME DATA LAB

Laboratório
Nacional de
Computação
Científica

Abordagem

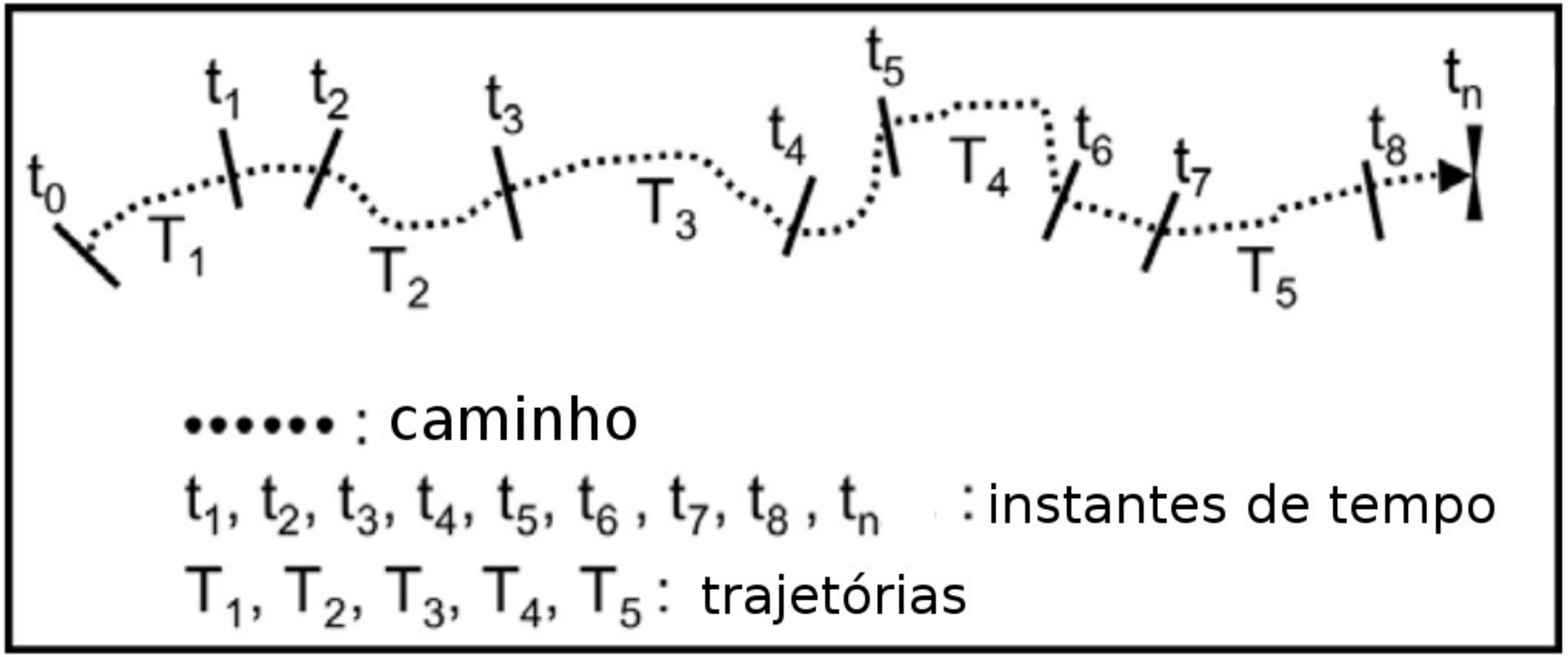
- Atleta e seus *elementos observáveis*
  - Variáveis de observação
- Variação dos elementos observáveis
  - Tempo
  - Estado do treinamento
- Observações pseudo-contínuas
  - Coleta de material em diversos momentos da vida do atleta
  - Interpolação provê uma simulação de variação contínua no tempo
- Observações discretas
  - Registros pontuais do estado do atleta
    - Medicação
    - Lesão
    - ...

Trajetória



- Modelar o processo de acompanhamento do atleta como a trajetória um elemento virtual no espaço de valores válidos
- Análise topológica de trajetórias
- Elemento de uniformidade entre as disciplinas
- Trajetória:
  - Atleta
  - Rotina (sequencia de estados)
  - Elemento Observável

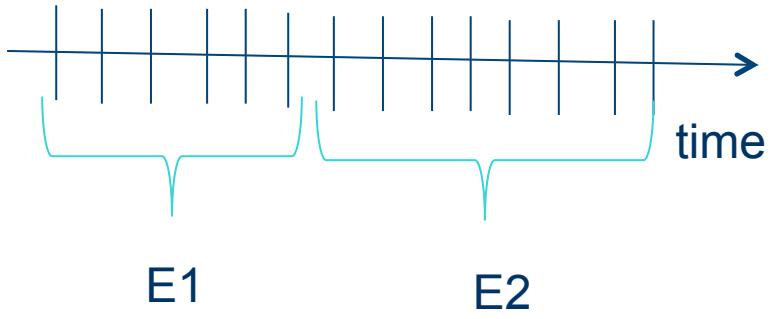
Modelo de Trajetória



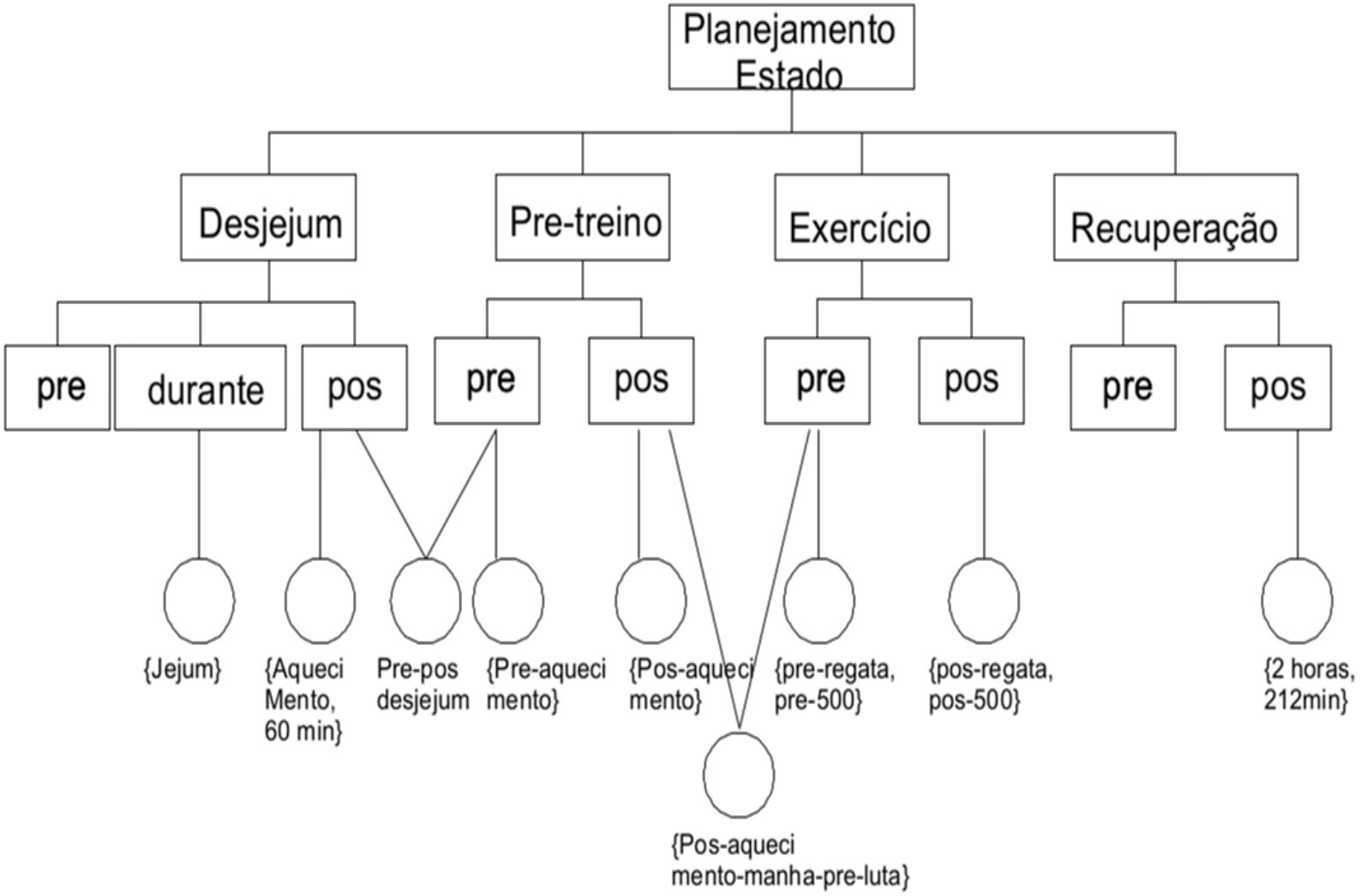
Um caminho espaço-temporal de um objeto em movimento. (Spaccapietra *et al., 2008)*

Estados

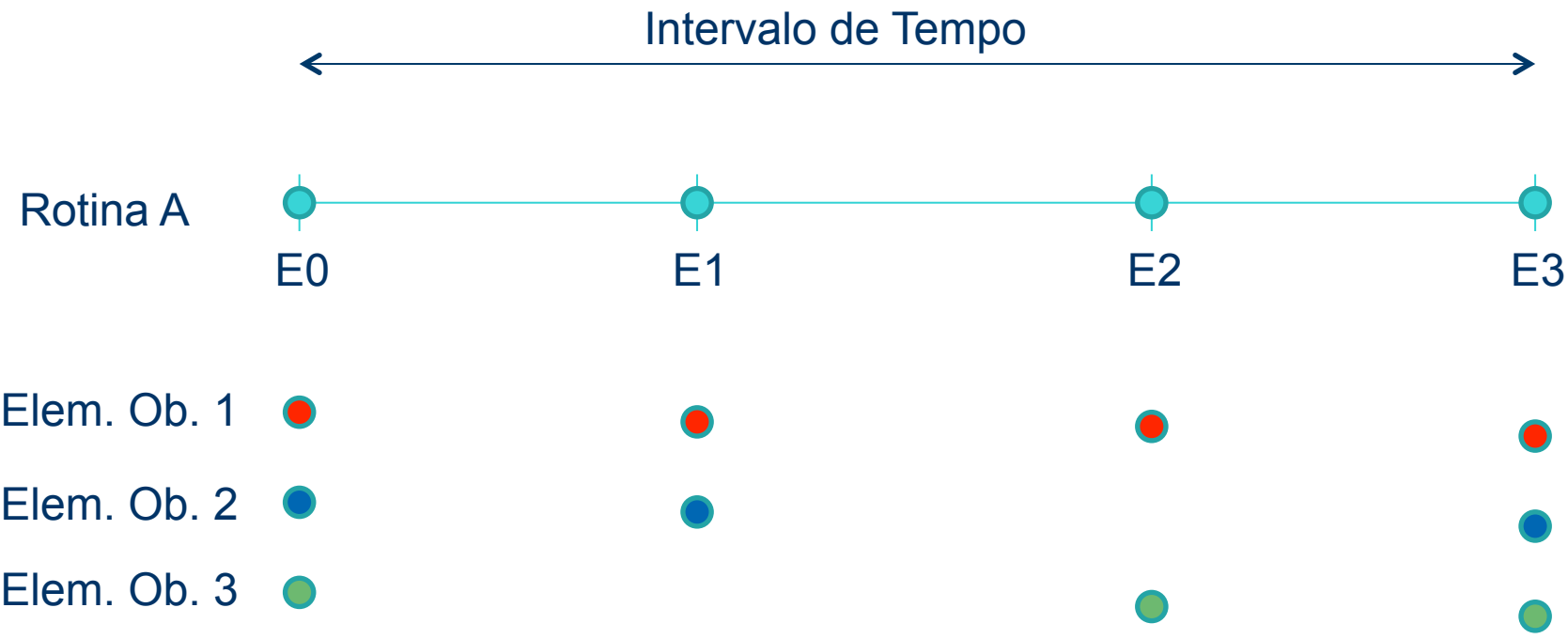
- Divisão do tempo segundo semântica do treinamento



Estados de Treinamento

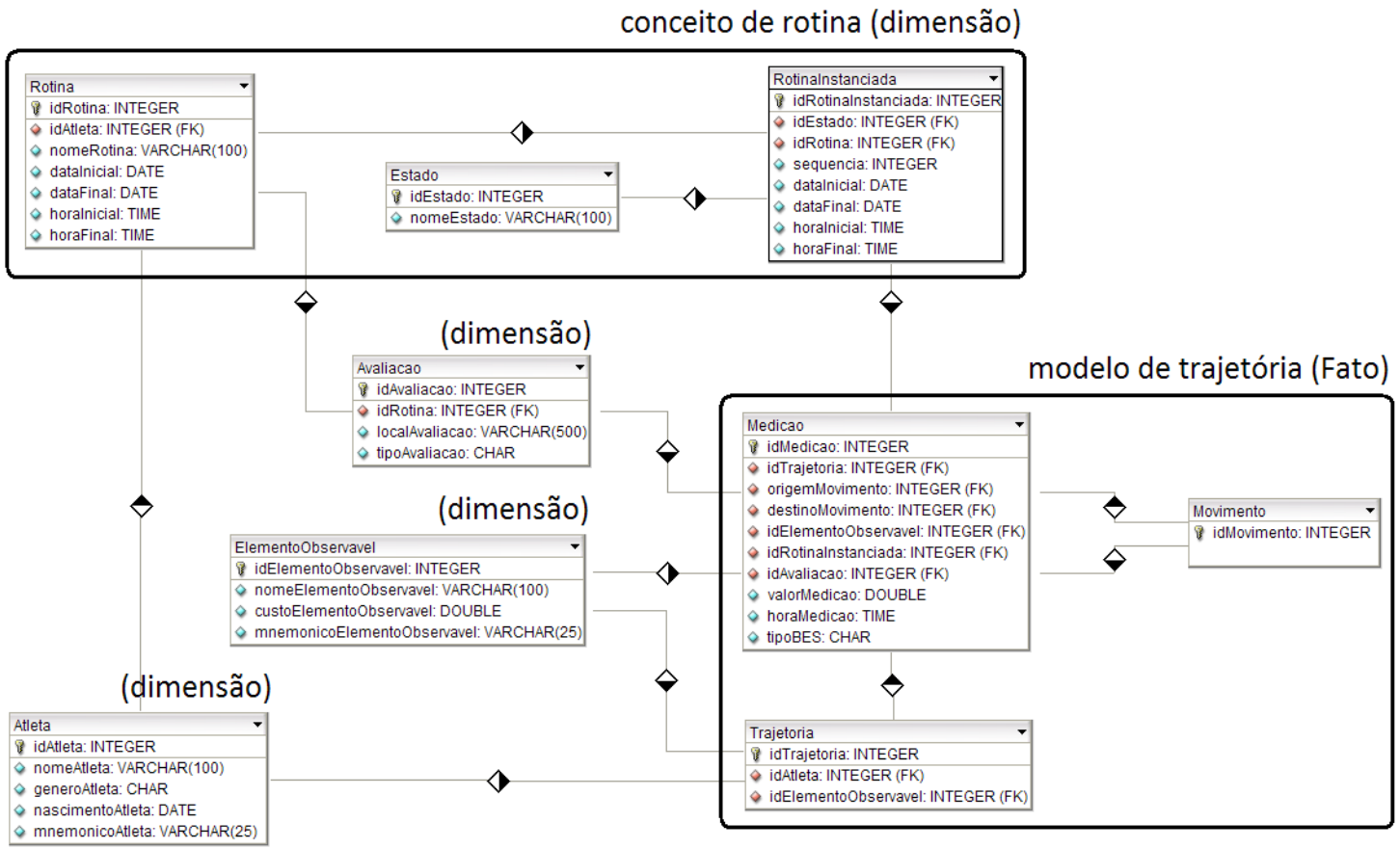


Rotina

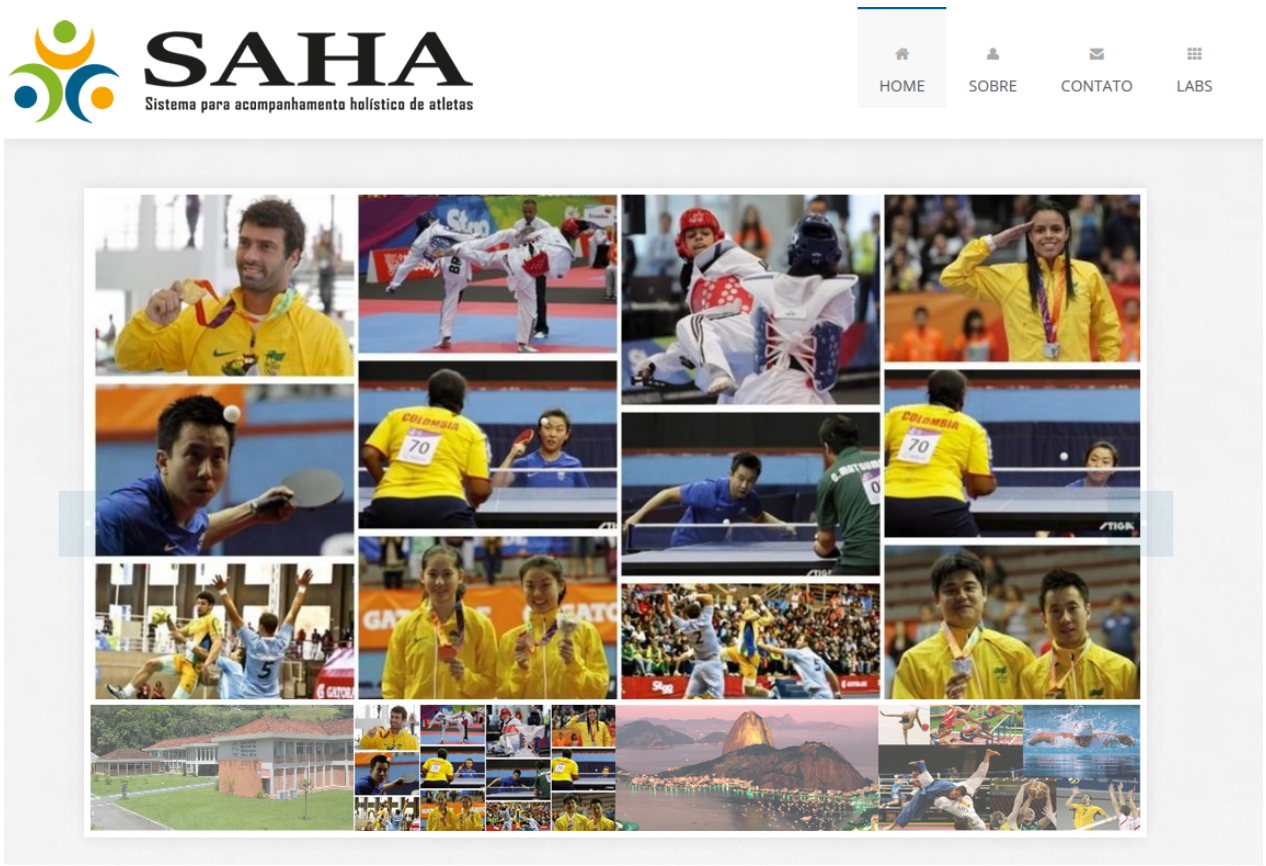


DEXL LAB
EXTREME DATA LAB

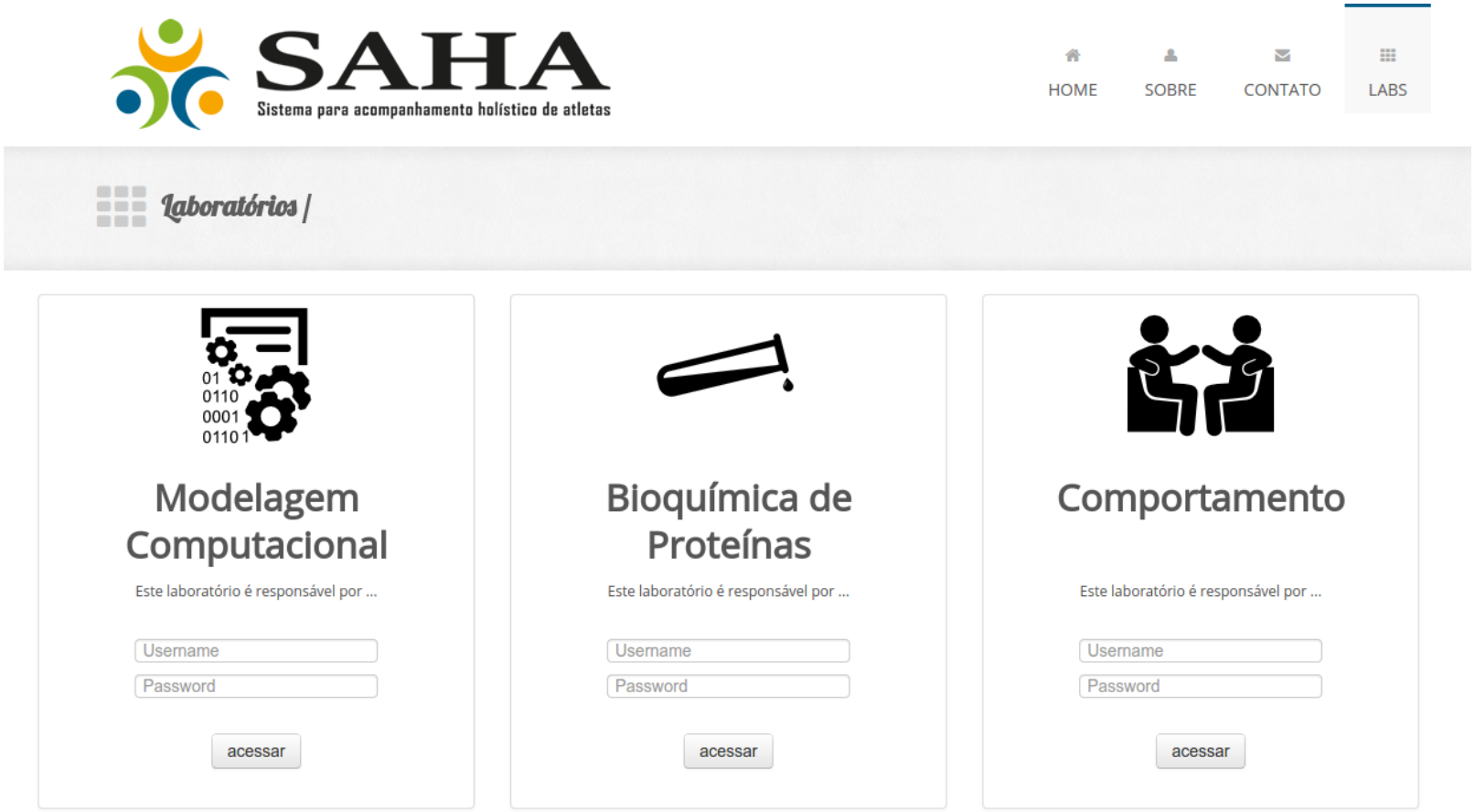
Depósito de Dados SAHA (simplificado)



SAHA - Home


SAHA
Sistema para acompanhamento holístico de atletas
HOME
SOBRE
CONTATO
LABS

Departamentos



Departamentos

Fisiologia do Esporte

Este laboratório é responsável por ...

Username

Password

acessar

Biomecânica

Este laboratório é responsável por ...

Username

Password

acessar

Base de Conhecimento

Este laboratório é responsável por ...

Username

Password

acessar

Coordenação INOVE

Este laboratório é responsável por ...

Username

Password

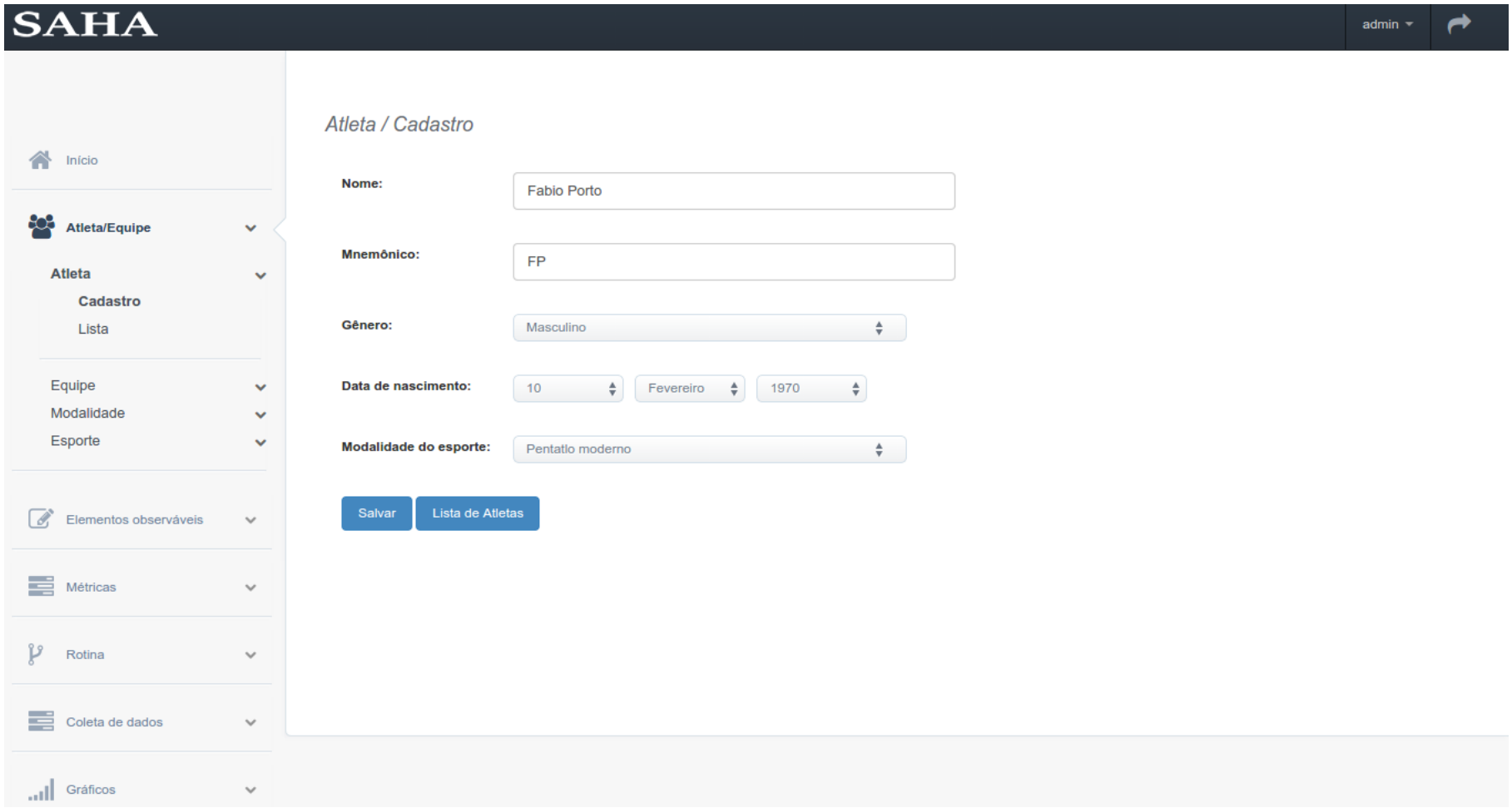
Gerência do Sistema

Este laboratório é responsável por ...

Username

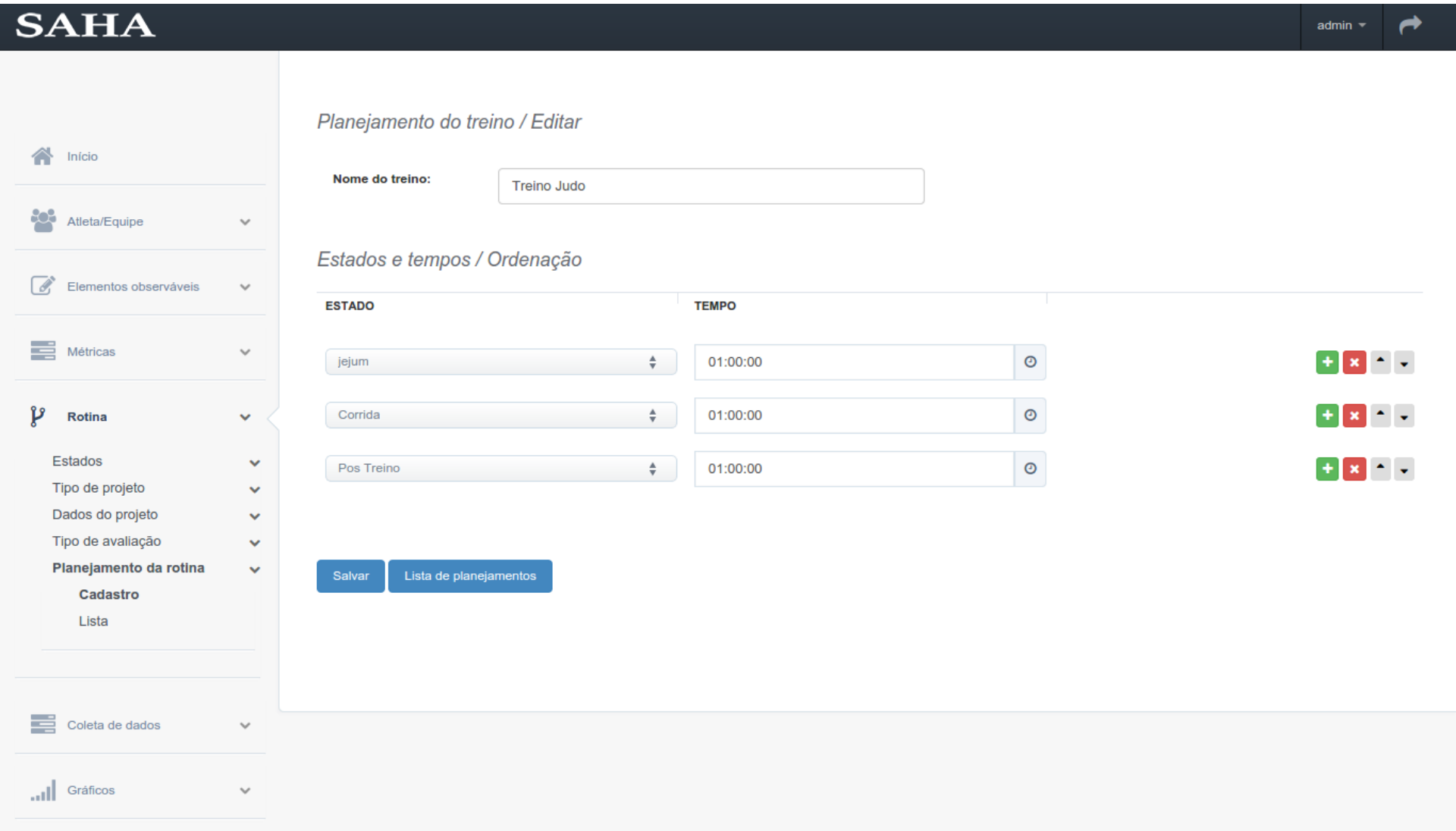
Password

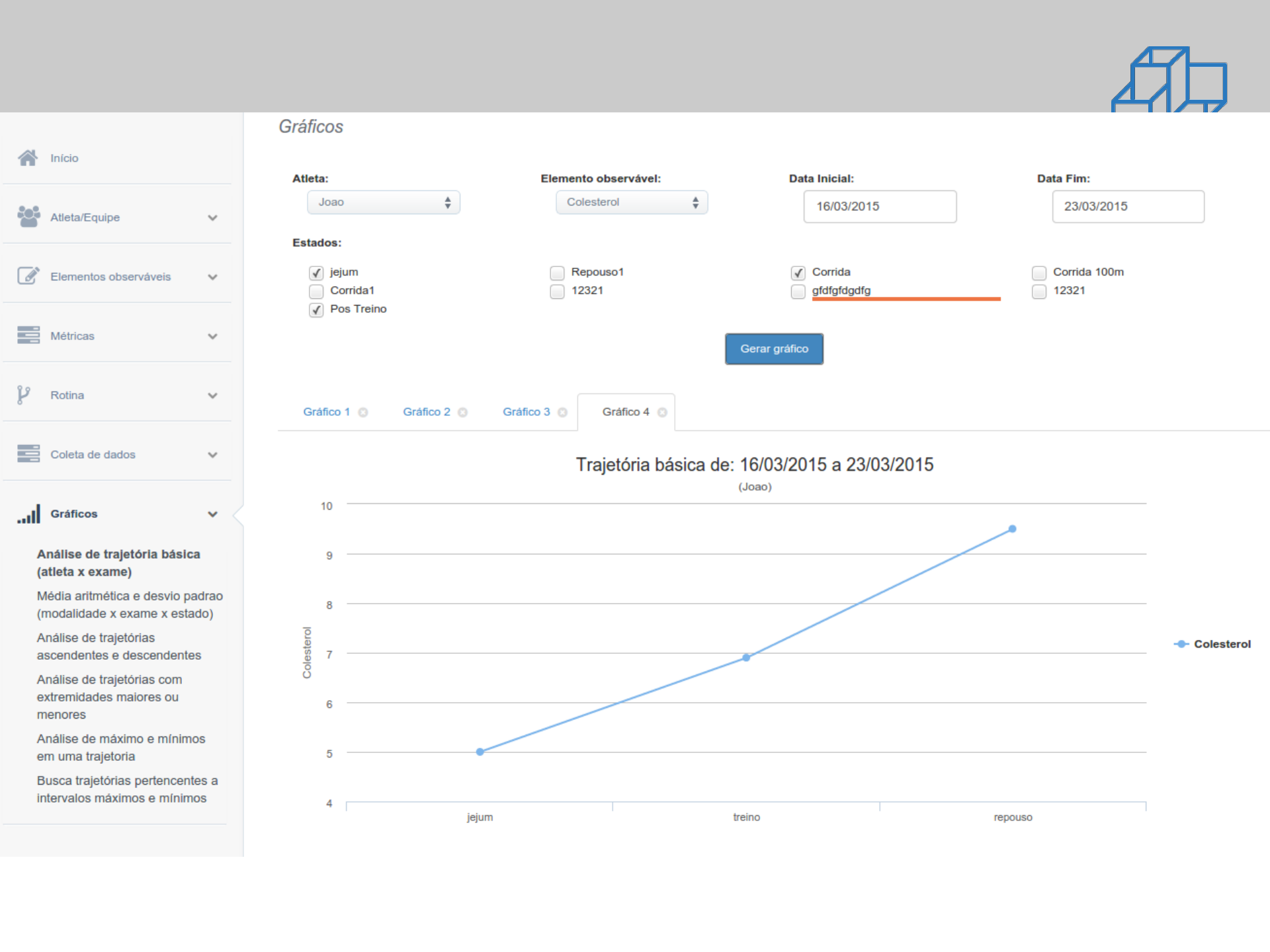
Atleta


SAHA
admin
Início
Atleta/Equipe
Atleta
Cadastro
Lista
Equipe
Modalidade
Esporte
Elementos observáveis
Métricas
Rotina
Coleta de dados
Gráficos
Atleta / Cadastro
Nome:
Fabio Porto
Mnemônico:
FP
Gênero:
Masculino
Data de nascimento:
10
Fevereiro
1970
Modalidade do esporte:
Pentatlo moderno
Salvar
Lista de Atletas

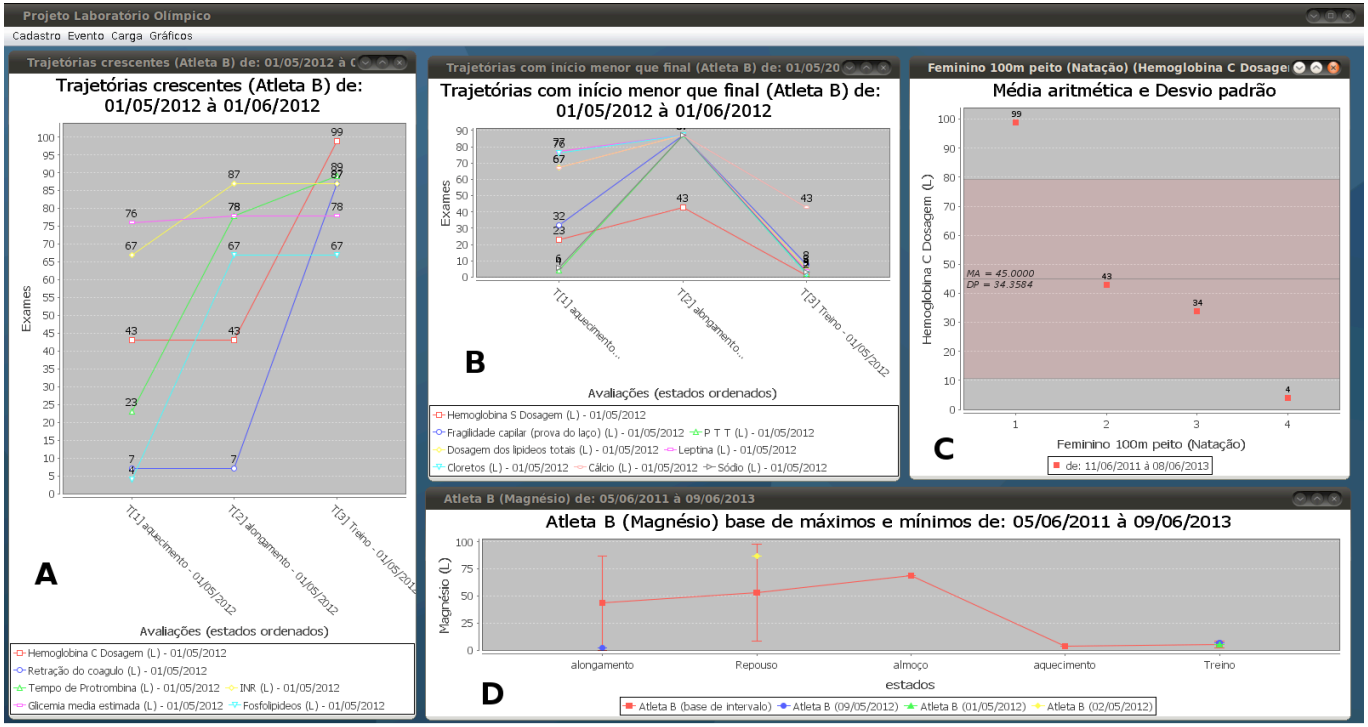
Rotina de Treinamento

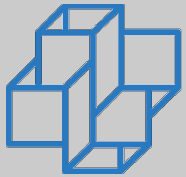
Rotina Executada




Gráficos
Início
Atleta/Equipe
Elementos observáveis
Métricas
Rotina
Coleta de dados
Gráficos
Análise de trajetória básica (atleta x exame)
Média aritmética e desvio padrao (modalidade x exame x estado)
Análise de trajetórias ascendentes e descendentes
Análise de trajetórias com extremidades maiores ou menores
Análise de máximo e mínimos em uma trajetoria
Busca trajetórias pertencentes a intervalos máximos e mínimos
Atleta:
Joao
Elemento observável:
Colesterol
Data Inicial:
16/03/2015
Data Fim:
23/03/2015
Estados:
jejum
Corrida1
Pos Treino
Repouso1
12321
Corrida
gfdfgfdgdfg
Corrida 100m
12321
Gerar gráfico
Gráfico 1
Gráfico 2
Gráfico 3
Gráfico 4
Trajetória básica de: 16/03/2015 a 23/03/2015
(Joao)
Colesterol
10
9
8
7
6
5
4
jejum
treino
repouso
Colesterol

Gráficos comparativos





CONCURRENCY AND COMPUTATION: PRACTICE AND EXPERIENCE
Concurrency Computat.: Pract. Exper. 2012; **24**:1497–1512
Published online 9 November 2011 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/cpe.1869

SPECIAL ISSUE PAPER

A metaphoric trajectory data warehouse for Olympic athlete follow-up

Fabio Porto [1,*,†], Ana Maria de C. Moura [1], Frederico C. da Silva [1], Adriana Bassini [3], Daniele C. Palazzi [1], Maira Poltosi [1], Luis Eduardo Viveiros de Castro [2,3] and L. C. Cameron [3]

[1] *Extreme Data Lab (DEXL Lab), National Laboratory of Scientific Computing (LNCC), Petrópolis, RJ, Brazil*
[2] *Brazilian Olympic Committee (BOC), Rio de Janeiro, RJ, Brazil*
[3] *Laboratory of Biochemistry of Proteins, Federal University of the State of Rio de Janeiro (UNIRIO), Rio de Janeiro, RJ, Brazil*

Int'l Association of Computer Science in Sport (http://www.iacss.org/)

Prof. Martin Lames
Technische Univ. Munchen

IACSS
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17.6.2015 : 2:23 : +0200

IACSS

- Objectives
- History
- IACSS-Board
- IACSS-Registration
- National associations
- Contact

International Association of Computer Science in Sport (IACSS)

The International Association of Computer Science in Sport (IACSS), and the predessesor (the WorkingGroup COSISP), have been founded to improve the international cooperation in the field of Computer Science in Sport. Obviously, the internationalization of this discipline is of great importance for the exchange of views, the discussion and presentation of current research results as well as the realization of joint research projects. This has also been become apparent by nine successful International Symposiums "Computer Science in Sport " in Cologne (1997), Vienna (1999), Cardiff (2001), Barcelona (2003), Hvar (2005), Calgary (2007), Canberra (2009), Shanghai (2011) and Istanbul (2013).

Cooperations

International Council of Sport Science and Physical Education (ICSSPE)

International Sports Engineering Association (ISEA)

European College of Sport Science (ECSS)

Latest News

10th International Symposium on Computer Science in Sport (IACSS 2015), September 09–11, 2015, Loughborough, UK

Our British colleagues from BACSSE organize the biannual conference 2015. It will be held in Loughborough from 9th-11th September, 2015. Due to many requests the submission deadline has been extended until 10th June, 2015. For further information visit the conference website http://gradients.lboro.ac.uk/iacss2015.

PACSS established in Portugal

The Portuguese Association of Computer Science in Sport (PACSS) was officialy founded at a meeting of 15 foundation members and board members

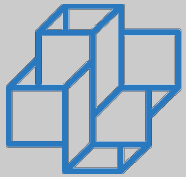
Comentários Finais

- Sportomics é uma nova abordagem de melhoria no esporte através da investigação científica interdisciplinar
- A ciência da computação tem um papel fundamental no desenvolvimento da sportomics com:
  - técnicas, modelos, metodologias
- Sportomics é uma fundamentalmente uma ciência de dados

Comentários

- Sportomics é centrada no ser humano
  - Tratamento de informações qualitativas
  - Medições de homens/mulheres normais não refletem as de atletas
- Análise integrada é um grande desafio
  - Correlações desconhecidas
  - Métodos de investigação
- Mecanismos de coleta de informações com menor impacto no atleta e em sua atividade

Colaboradores



- Membros do Laboratório DEXL
  - Prof. Ana Maria de C. Moura
  - MSc Frederico Corrêa da Silva
  - Bolsista Debora Cerqueira
  - Bolsista Dionisio Porto
  - Bolsista Enver Choque
  - Bolsista Adolfo Simões
- UNIRIO
  - Prof. L. C. Cameron
  - Dr. Adriana Bassini
- COB
  - Dr. Sidney Cavalcante,
  - Julio Noronha
- UFJF
  - Prof. Mauricio Bara
- INTO
  - Dr. José Inacio Salles
- COPPE- Crie
  - Prof. Marcos Cavalcante
  - Gilberto Sanpaio

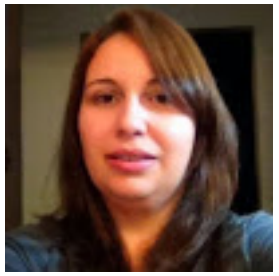
Equipe SAHA

Esp. Dionisio Porto

Esp. Adolfo Simões

MSc Frederico Corrêa da Silva

Esp. Enver Choque



Esp. Debora Cerqueira

Obrigado !☺

Fabio Porto (fporto@lncc.br)

Ministério da
Ciência, Tecnologia e Inovação