IA for smart cities, with a focus on public health

Data Science and Statistics Webinar

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ICMC USP SÃO CARLOS

Applied Research Centers in Artificial Intelligence

- National call for funding 8 applied AI research centres
  - São Paulo Research Foundation (FAPESP), Ministry of Science, Technology and Innovation (MCTI) and Brazilian Internet Steering Committee (CGI.br)
  - 4 (6) centres in 2021 (and 4 (2) in 2022)
    - Health
    - Agriculture
    - Industry
    - Smart cities
    - Public and private funding

Chamada de Propostas FAPESP – MCTIC - CGI.BR para Centros de Pesquisas Aplicadas em Inteligência Artificial

NOTA: O prazo para apresentação de propostas foi ampliado e a nova data limite é 20 de julho de 2020.

NOTA 2: O CGI/MCTIC e a FAPESP decidiram excluir a limitação prevista no edital segundo a qual poderia ser submetida apenas uma proposta por instituição sede. Essa alteração possibilitará que pesquisadores vinculados a diferentes unidades de uma mesma instituição submetam propostas na chamada, garantindo igualdade de condições entre instituições e grupos de pesquisa e um processo competitivo para a escolha das melhores propostas.

NOTA 3: Dado que o prazo de submissão foi estendido até julho de 2020, o cronograma de avaliação foi adaptado e a previsão de publicação do resultado da chamada é a partir de Fevereiro de 2021.

Colaboração entre a Fundação de Amparo à Pesquisa do Estado de São Paulo – FAPESP, o Ministério de Estado da Ciência, Tecnologia, Inovações e Comunicações – MCTIC e o Comitê Gestor da Internet no Brasil CGI.br.

CENTROS DE PESQUISAS APLICADAS EM INTELIGÊNCIA ARTIFICIAL

IARA Network Proposal

- Applied AI Research Centre in Smart, Sustainable and Inclusive Cities
  - **FAPESP-MCTIC-CGI.br** call for Applied Research Centers (CPA) in AI
- Coordinated by University of São Paulo (**USP**), with participation of:
  - Support from 11 Brazilian cities
  - Participation of ~40 Brazilian Science & Technology Institutions (**STIs**)
    - More than 200 researchers
  - Funding from companies and from Brazilian States Funding Agencies
  - Collaboration with 20 international STIs

Brazilian STIs

International collaborations

- ConceptionX (UK)
- Chalmers University of Technology (Sweden)
- Royal Institute of Technology, KTH (Sweden)
- Uppsala University (Sweden)
- Universidade de Aveiro (Portugal)
- Universidade de Nova de Lisboa (Portugal)
- Universidade de Porto (Portugal)
- Scuola Superiore Sant'Anna (Italy)
- Università Degli Studi di Milano (Italy)
- The National Physical Laboratory (UK)
- University of London (UK)
- University of Bath (UK)
- University of Cork (Ireland)
- University of Bordeaux (France)
- University of La Rochelle (France)
- University of Poitiers (France)
- University of Waikato (New Zeland)
- New South Wales University (Australia)
- North Carolina State University (USA)
- New York University (USA)
- University of Maryland (USA)
- University of Twente (Holland)
- University of Guelph (Canada)
- Université Laval (Canada)

Sponsorship of companies

Grupo SPLICE

intel

STELLANTIS

Cidade dos Lagos

CILLATECHPARK

IPEC GUARAPUAVA Instituto para Pesquisa do Câncer

jacto

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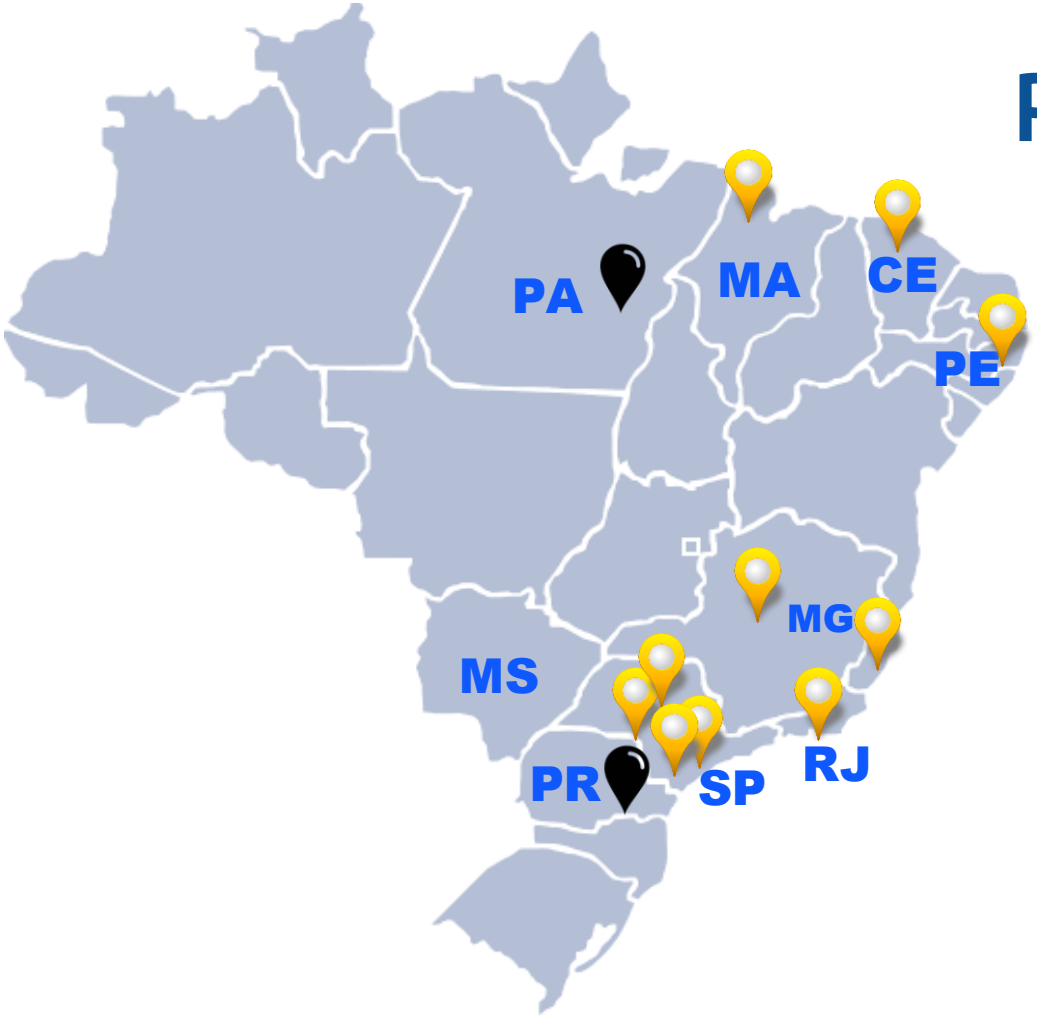
jacto

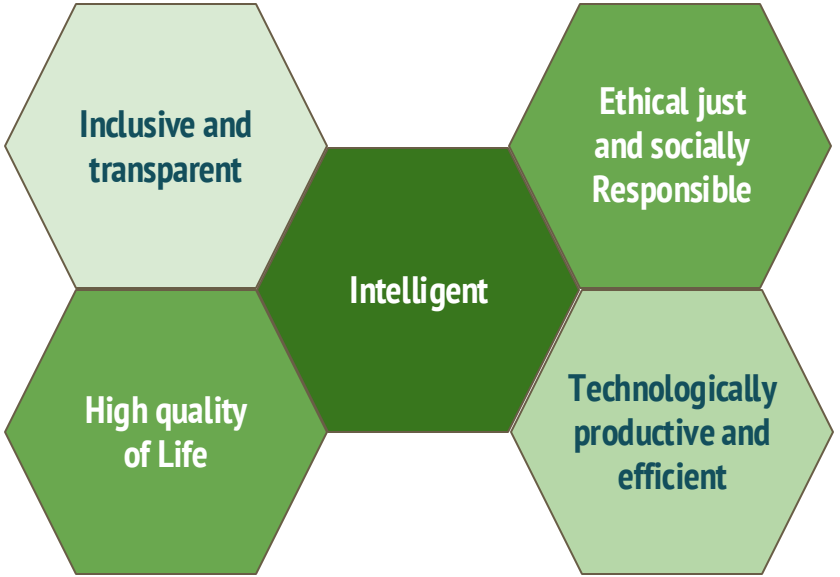


Partner Cities

- Albertina (MG)
- Alcântara (MA)
- **Canaã dos Carajás (PA)**
- Colatina (ES)
- Fortaleza (CE)
- **Guarapuava (PR)**
- Monteiro Lobato (SP)
- Niterói (RJ)
- Recife (PE)
- São Carlos (SP)
- São José dos Campos (SP)
- Sorocaba (SP)

IARA and sustainability

Actions to improve the quality of life in urban and rural spaces



Inteli.gente platform

- Data intelligence for the Brazilian smart cities platform
  - Brazilian Ministry of Science, Technology and Innovation (United Nations)
  - Access Link: https://inteligente.mcti.gov.br/
- Objectives
  - Diagnose how well a city meets the requirements of a **smart and sustainable city**
    - Maturity Level
    - Propose guidelines and lines of action for the development of policies for **smart and sustainable cities**
    - National, State and Municipal public policies

Inteli.gente platform

- Maturity Model of Brazilian Smart and
- Sustainable cities (MMCISB)
    - Based on ITU maturity model for Smart and Sustainable Cities
- Uses 43 indicators in 4 dimensions (axes):
    - Economical
    - Sociocultural
    - Environmental
    - **Institutional Competence in municipal management**
- Uses two evaluation modules

Each indicator has 7 evaluation levels

https://cidadesinteligentes.hmg.apps.kloud.rnp.br/

Indicators for the first diagnosis

Sustainable Development and ICT

Economical

- Water/Sewage
- Open Data
- Housing
- Connectivity Infrastructure
- Innovation
- Solid Waste
- Townhall Online Services
- Technology Systems for Urban Management
- Mobility
- Urbanization

Environmental

- Water/Sewage
- Green Areas
- Energy
- Air Quality
- Solid Waste

Sociocultural

- Culture/leisure
- Education
- Disaster Management
- Social Inclusion
- Public Participation
- Health

Adapted from https://cidadesinteligentes.hmg.apps.kloud.rnp.br/metodologias

Indicators for the second diagnosis

Institutional Capabilities in Municipal Management

Strategy

- Planning
- Collaborative Governance
- Technological Governance
- Public Policies
- Vision and concept of cities

Infrastructure

- Urban and ICT Infrastructure Planning
- Coverage and Quality
- Institutionalization of IT management
- Hardware and Software Infrastructure
- IT Governance

Data

- Usage and Security Planning
- Digitalization of Databases
- Open and transparent
- Database Integration and Interoperability

Services

- Planning
- Integration and Interoperability
- Governance Online public service
- Urban Services

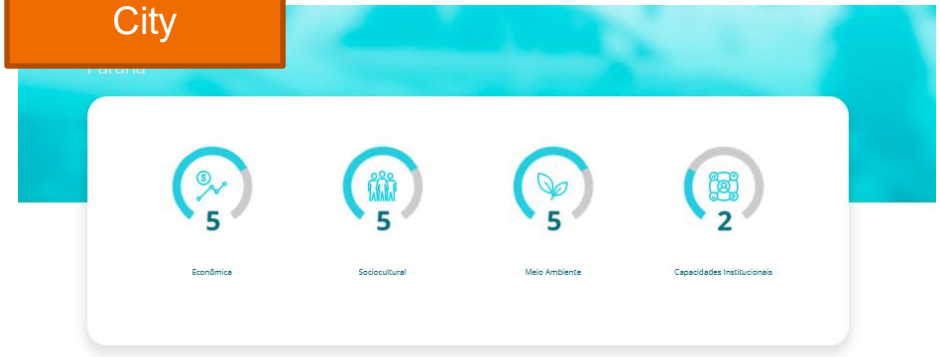
Monitoring

- Planning and evaluation
- Coordination of the actions
- Perception of the quality
- Transparency

Adapted from https://cidadesinteligentes.hmg.apps.kloud.rnp.br/metodologias

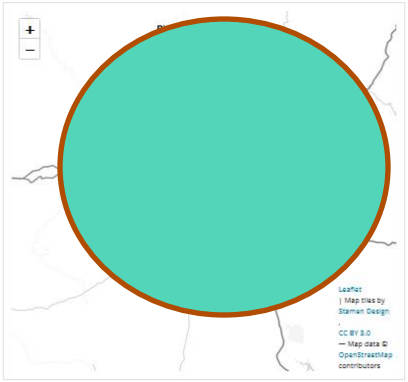
Consulting via Inteli.gente

City



Caracterização

População total estimada do município	1.933.105
PIB per capita do município	44.384,92
População ocupada com vínculo formal	883.930
Índice de desenvolvimento humano do município (IDH-M)	0,823
Capacidade de pagamento dos municípios	B
Índice de GINI da renda domiciliar per capita	0,565
Rede de influência da cidade	Metrópole



Canaã dos Carajás

- Smartphone app for citizen engagement
- Car as a mobile sensor
  - Monitoring pavement condictions
  - Air quality assessment
  - Safety of bycicles and pedestrians
- Autism diagnosis in classrooms
- Leishmaniosis prevention
  - High incidence in the city

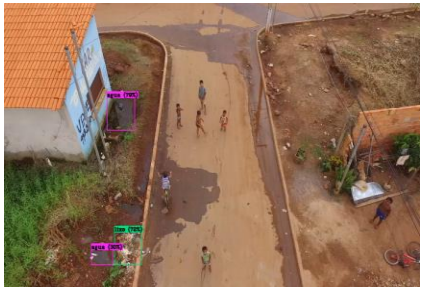
Canaã HDI: 0,276 (1990) 0,456 (2000) 0,673 (2010)
Brasil: 0,765

https://www.canaadoscarajas.pa.gov.br

Canaã dos Carajás

- Two of the reasons for the high occurrence of leishmaniosis:
  - Accumulation of garbage on plots of land and streets that can feed sandflies
  - Still water, where larvae of sandflies can survive
- How to deal with them?
  - Use drones to monitor these regions, collecting images from them
    - Apply AI to identify garbage accumulation and still water



Canaã dos Carajás

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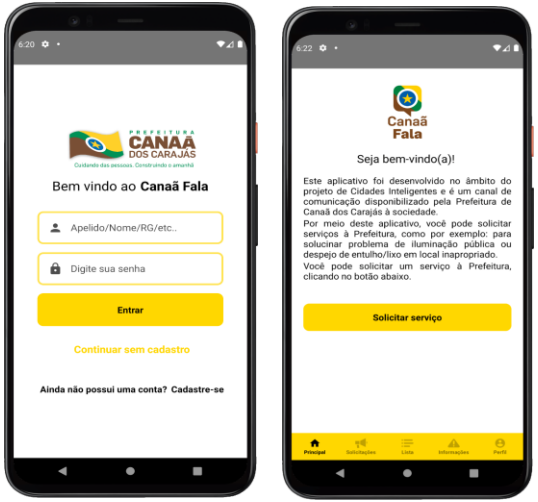
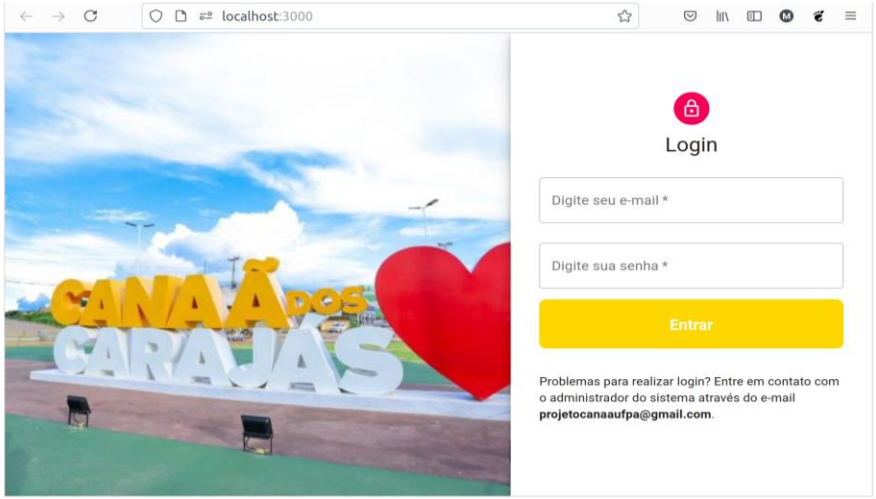
Increasing citizen engagement

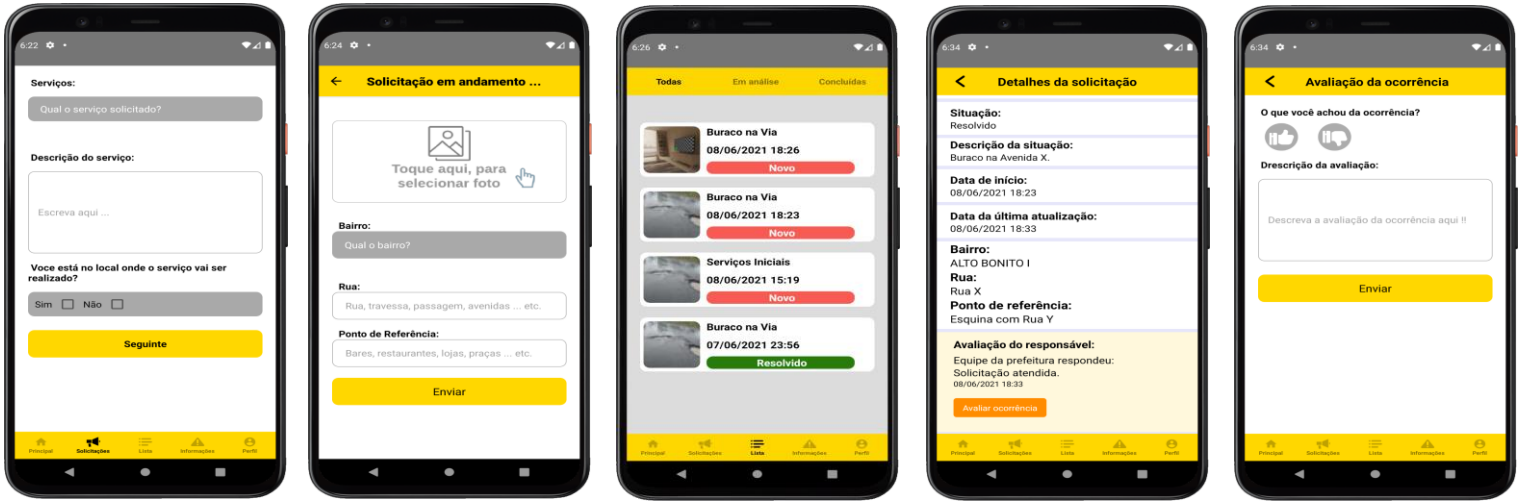
- Canaã Fala (Speaks) mobile app
  - Smartphone app for direct communication between citizens and the City Hall





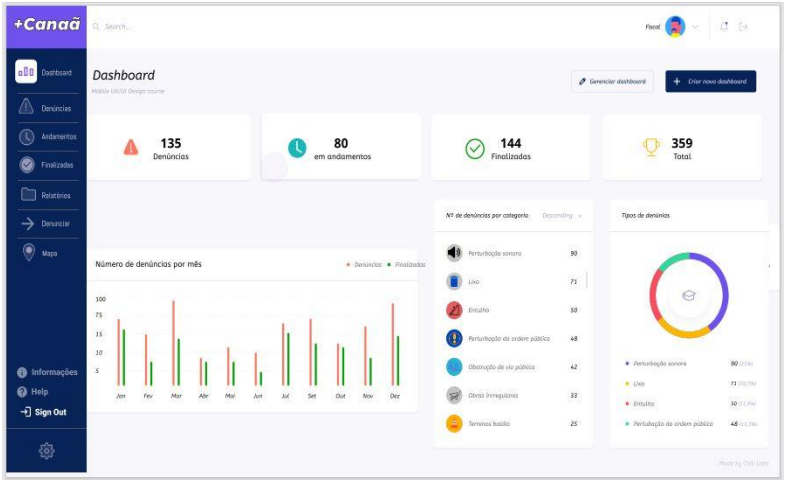
Increasing citizen engagement

- Canaã Fala (Speaks) mobile app
  - Citizens can request, monitor and evaluate the services provided by the City Hall



Increasing citizen engagement

- Canaã Fala (Speaks) app dashboard
  - City identifies and prioritizes infrastructure maintenance and services requests
    - And monitor their status
  - Communication with city health services
    - Schedule medical appointments and clinical exams
    - Send exam results from to patients and physicians



Guarapuava (PR)

- Helthcare Living Lab
  - Digital health experiments
    - Rare and complex diseases
    - Clinical, physical conditioning, genomic and nutrition data
  - Map population genomic diversity
  - Follow 4,500 people, in 15 years
    - Adding new people every year

Guarapuava Cancer Center
Cancer Hospital (second phase)

Guarapuava

- Rare diseases
  - When affect < 1 in 2,000 individuals
    - There are ~7,000 reported rare diseases
      - Together, affect up to 8% of the population
    - Less than 10% receive disease-specific treatment
  - 80% have genetic causes
  - Hard to discover in their early stages

Guarapuava Cancer Center
Genomic Research Centre (first phase)

Guarapuava

- Complex diseases
  - Caused by combination of genetic, environmental and lifestyle factors
  - Alzheimer, Asthma, Depression, **Cancer** , Diabetes, **Epilepsy**, Parkinson, Cardiovascular disease,...
    - The earlier they are detected, the more successful is the treatment
    - Will become more common as lifespan increases

Guarapuava Cancer Center
Genomic Research Centre (first phase)

Living lab for cancer diagnosis project

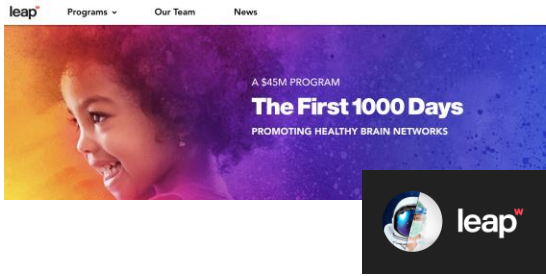
Questionnaire

- Age
- Contact with animals
- Income
- Level of schooling
- Life style
- Healthcare
- Medicines taken
- Family history of diseases
- Sleep quality

Collection of biological material

- Blood
- Saliva
- Feces
- Spirometry
- Apnea and Hypopnea index
- Cystic fibrosis

First 1000 days (1kD)



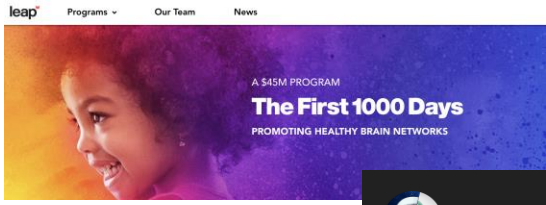
- Evaluate the cognitive development of 1000 children in their first 1000 days
  - Using samples from at least 10 different countries/regions
- Monitor executive function
  - One of the main alternatives to evaluate and monitor cognitive development
- About 20% of 3-year-olds in the world have poor executive function development
  - They will probably be 80% of adults who will need social or economic assistance

- Baylor College of Medicine
- University of Cape Town
- University of York
- Liggins Institute, University of Auckland & Singapore Institute for Clinical Sciences
- Princeton University
- University of Cambridge
- Nanyang Technological University
- Stanford University
- University of São Paulo (USP)

Germina

- Yale University

Germina

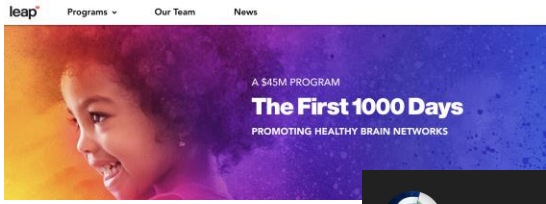


leap

GERMINA

- Brazilian research team
  - Coordinated by USP Medical School (FMUSP)
- Collects and analyses
  - **Clinical data**: EEG, cognitive and vision
  - **Social data**: Maternal care, environment, nutrition and social support
  - **Genetic analysis data**: DNA, RNA and microbiome
- Multidisciplinary team
  - Biology, computer science, medicine, nutrition, psychology...

Germina



leap

GERMINA

JORNAL DA USP

PORTAL DA USP – FALE CONOSCO – WHATSAPP – ENVIE UMA PAUTA – PODCASTS – RÁDIO USP – TV USP

ATUALIDADES | CIÊNCIAS | CULTURA | DIVERSIDADE | EDUCAÇÃO | INSTITUCIONAL | RÁDIO USP | TECNOLOGIA | UNIVERSIDADE | BUSCA

ício > Ciências > Chumbo é encontrado no leite humano e associado a problemas no desenvolvimento de bebês

Chumbo é encontrado no leite humano e associado a problemas no desenvolvimento de bebês

Estudo avaliou a contaminação por metais no leite humano e sua associação com o desenvolvimento neuropsicológico em crianças de três a 16 meses

Publicado: 13/09/2024 às 13:32 Atualizado: 16/09/2024 às 18:20

Texto: Jean Silva*
Arte: Joyce Tenório**

Loops project

- Diagnosis and prognosis of head and neck cancer
  - Biomarkers extracted from histopathological mages
  - First steps: tongue cancer diagnosis
- Collect data from odontology clinics
  - Using images obtained by smartphones
- Participants

https://dentalreach.today/how-to-use-your-mobile-phone-for-dental-photography/

AC Camargo
Universidade de Chicago
Universidade de Sheffield
Universidade Estadual de Campinas
Universidade Federal de São Paulo
Universidade de São Paulo

Loops project

- Benefits from tongue cancer diagnosis from images
  - Data can be collected with easiness and low cost
  - Expands number of places for data collection
- Challenges
  - Photo Framing
  - Brightness variation
  - Noise handling (e.g. use of flash)

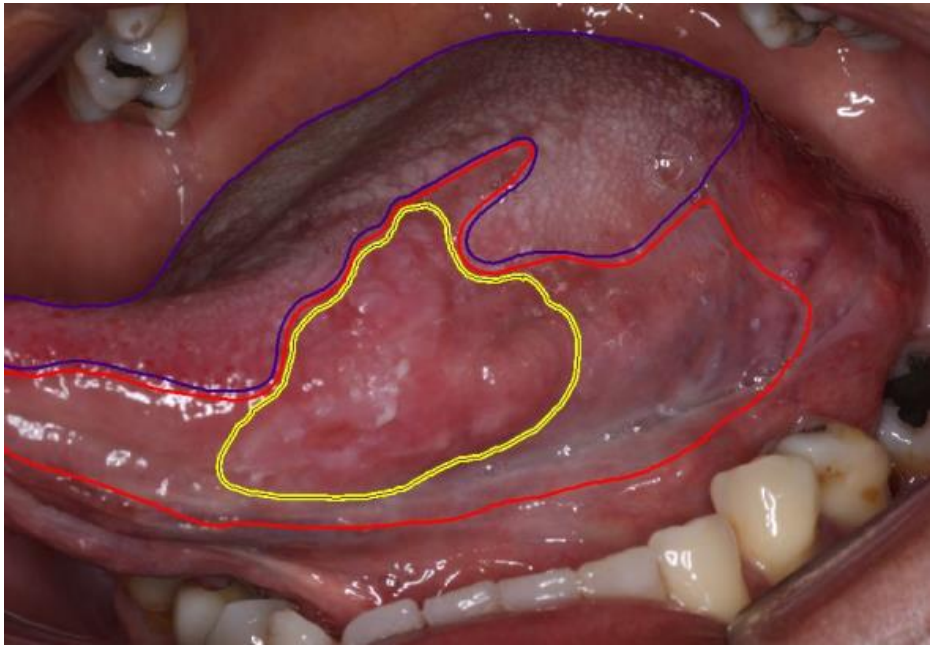
https://bayshoredentalstudio.com/effective-dental-lab-communication-through-smartphone-technology/

Loops project

https://www.photomed.net/sdl.htm

Loops project

- Image collection
- Image annotation
- Image segmentation
    - Technique Recommendation
- Image Classification
    - Transfer learning
- Validation by expert



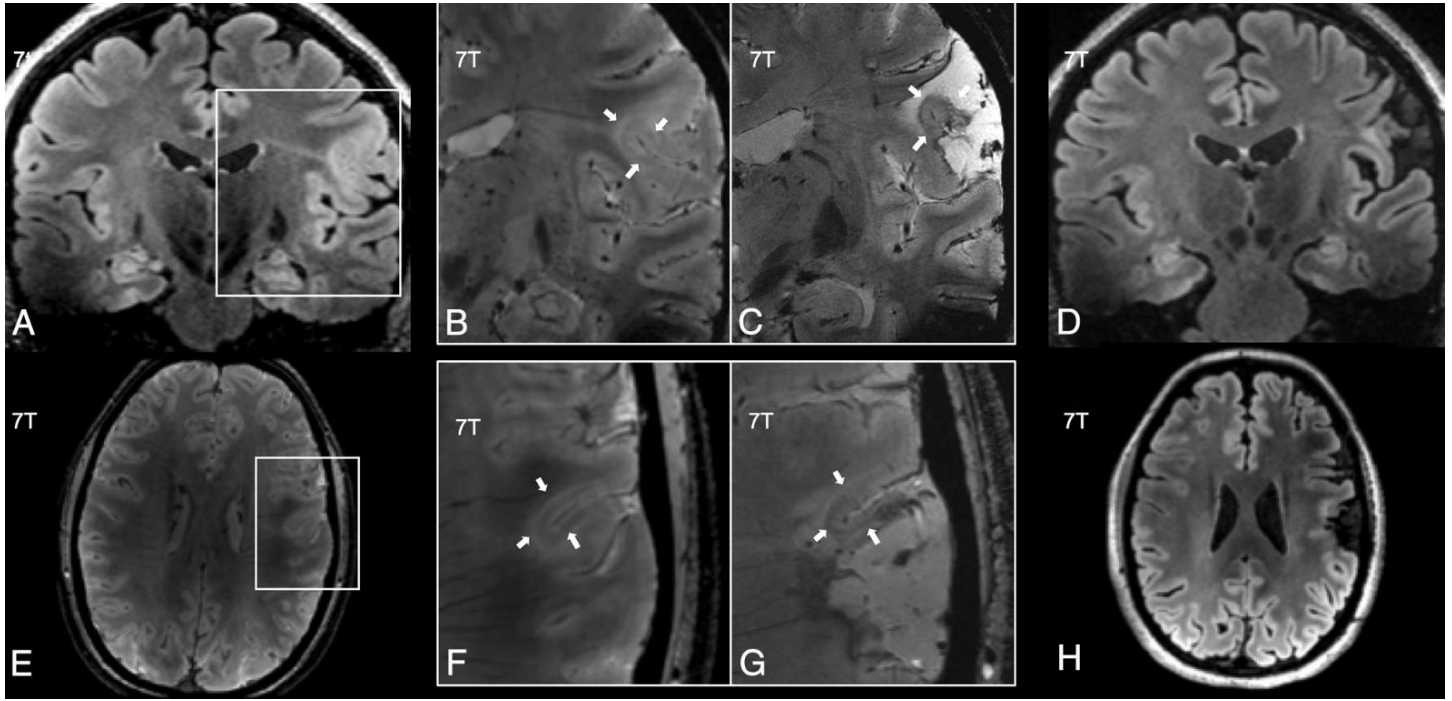
Treatments for dysplasia (epilepsy)

- Most frequent neurological disease in the world
  - 50 million people, according to the WHO
- Characterized by repeated epileptic seizures
  - Synchronous or excessive neuronal activity in the brain caused by hypersensitivity and abnormal firing of neurons
- Main types of seizures:
  - Focal or partial: starts in one area of the brain and spreads across the brain
  - Generalized: occurs in both sides of the brain, can start either as focal seizures orsimultaneously over both sides
  - Combination of focal and generalized , unknown area

Treatments for dysplasia (epilepsy)

- Medication
  - About 1/3 of the patients do not respond well to medication (**refractory epilepsy**)
- Neuromodulation
  - Relief of symptoms that cause discomfort or disability (palliative)
- Surgical
  - Generally more successful (especially for refractory epilepsy)
  - Anatomical or functional removal of the epileptic focus region (resecting)
  - Challenge:
    - Identifying the correct region (preoperative investigation)

Surgical resection



Resection region identification

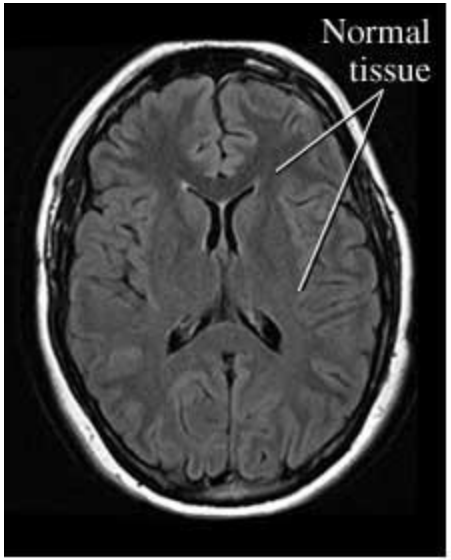


Figure 1

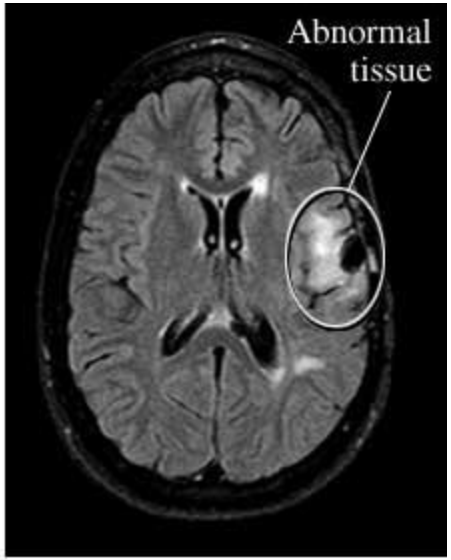


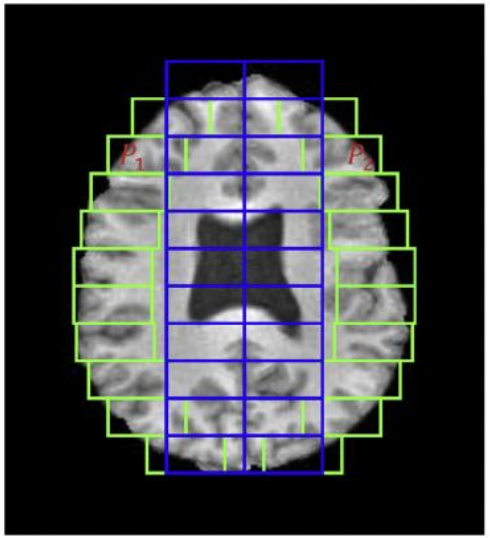
Figure 2

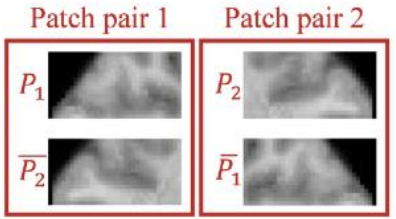
Surgical resection using MRI imaging **increases** the chance of complete seizure control **by 2.5 times**

https://www.cigna.com/individuals-families/health-wellness/hw/seizure-mri-zm5010

Resection region identification

- Division of the image into patches (Wang et al., 2020)
  - Automated detection of focal cortical dysplasia using a deep convolutional neural network Wang et al. (2020)
- Better performance
- Challenge:
  - Definition of patches shape and size)



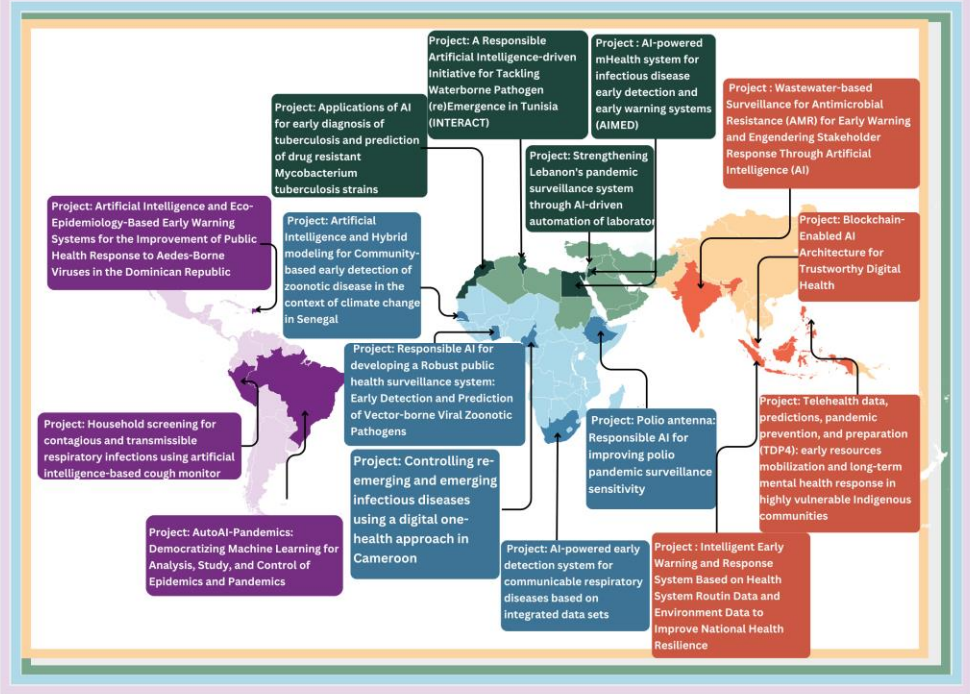


AI for Pandemic & Epidemic Preparedness

- AutoAI-Pandemics: Democratizing Machine Learning for Analysis, Study, and Control of Epidemics and Pandemics
  - Researchers from Bioinformatics, Data Science, Computing, Epidemiology, Artificial Intelligence and Clinical Medicine
  - Automated machine learning (AutoML) tool to democratize
    - Monitor epidemic and pandemic occurrence and support public policies
    - Omics (genomics, proteomics, metabolomics, ...) for drug discovery and genome mining of pathogens
    - Identify epidemic and pandemic related fake news and deep fake

AI for Pandemic & Epidemic Preparedness

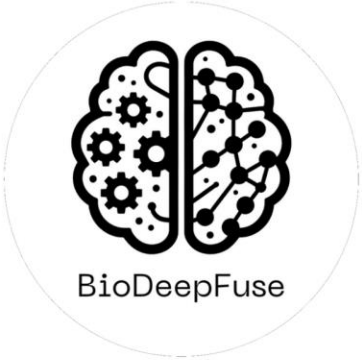
AutoAI-Pandemics
Democratizing Machine Learning



AI-Pandemics Tools

BioAutoML

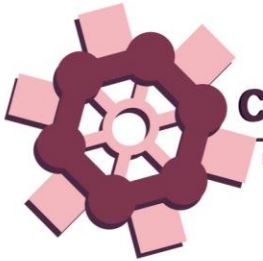
BioPrediction



BioDeepFuse

AutoAI-Pandemics

Democratizing Machine Learning



ChemAutoML

Democratizing Cheminformatics

MathFeature

ITT- Is That True?

Atypical growth prediction I

- Diagnosis of growth hormone deficiency (GHD) in childhood
  - Needs clinical and auxological evaluation (height and weight data on a growth chart)
    - Combined with neuroradiological studies, biochemical tests and the identification of low growth hormone (GH) secretion
  - Criteria adopted for different countries vary
    - There is no test that is considered "gold standard“
- AM tool to reduce exam costs to allow good diagnoses to be made in any region of the country

Atypical growth prediction II

- To find factors that pass from generation to generation (intergenerational) to predict the growth of Brazilian children
  - Weight and length in the first 1000 days of life
  - Intergenerational variables of parents and babies since prenatal care
- AM tool (system) to estimate individual risk for short stature by age and gain of inadequate weight up to two years of age
  - Automate risk scoring for children with low weight at birth

Personalized hospital trajectory

- Explores alternatives for personalized health planning and modeling
  - Personalized sequence of exams for cancer diagnosis
  - Combines machine learning and optimization
    - Predict disease status
    - Optimize the sequence of exams
- Reduce time to diagnosis
  - Can increase treatment success and decrease treatment costs

Cities of the future program

SECRETARIA DE DESENVOLVIMENTO ECONÔMICO CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

MINAS GERAIS
DIÁLOGO EQUILÍBRIO TRABALHO

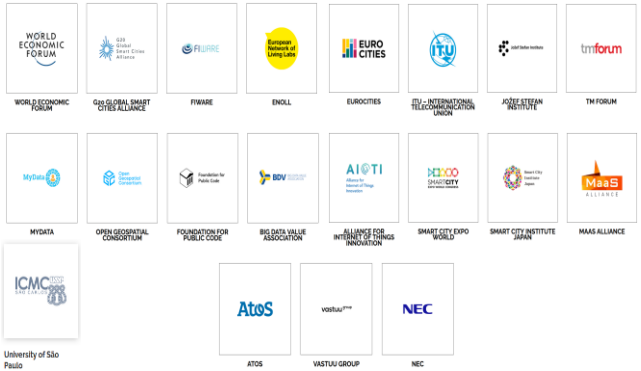
Health AI

HEALTH AI
The Global Agency for Responsible AI in Health

- Non-profit organization, working with WHO
- Main goal: to expand the capacity of the countries to regulate AI in health in well being
    - Strength policies, regulations, and institutions for the effective governance of AI technologies in health
        - Reducing the risks and costs of applying AI to health systems and services
        - Advance equity
- Community of Practice (CoP) committee
    - Keeps track of regulation of AI in healthcare, support development and sharing of tools and ensure that diverse perspectives drive innovation and influence change

Open & Agile Smart Cities (OASC)

- International network of cities for partnerships with municipal managers:
  - Of all sizes and from all countries
  - Supports the digital transformation process in municipalities
  - Facilitates sharing and reuse of data-driven digital solutions
    - Avoids supplier dependency
    - Reduces innovation costs
    - Improves efficiency



INCT IAPROBEM

- National Science and Technology Institute (INCT) of Artificial Intelligence for Social Good
  - 40% of the researchers are women
- Around 100 INCTs, in different areas, were selected in a national call
  - CNPq
- Four focal points
  - Natural disasters
  - Environment
  - Health
  - Social inclusion

IARA at COP 30

- UN Climate Change Conference (COP 30)
  - City of Belem, State of Para, Brazil, 2025
- Government of Pará invited IARA to present initiatives and tools for smart cities
  - Intelligent detection of property, people and waste
  - Smart mobility with electric charging and smart aisles
  - Public health solutions for metropolitan regions
  - Culture and environmental health

Go raibh maith agat

Gracias

Adúpẹ́

Thank you

Danke

شكرا

Σας ευχαριστώ!

Dhanyawaad

Merci

Aguyje

Obrigado

תודה