Certificate I: Understanding AI and Machine Learning in Africa

Course AIML02: AI and Machine Learning in Africa

Module 4: Deployment of AI and Machine Learning in Africa

Lecture 1: Machine Learning for the Developing World

Carnegie Mellon University
Africa

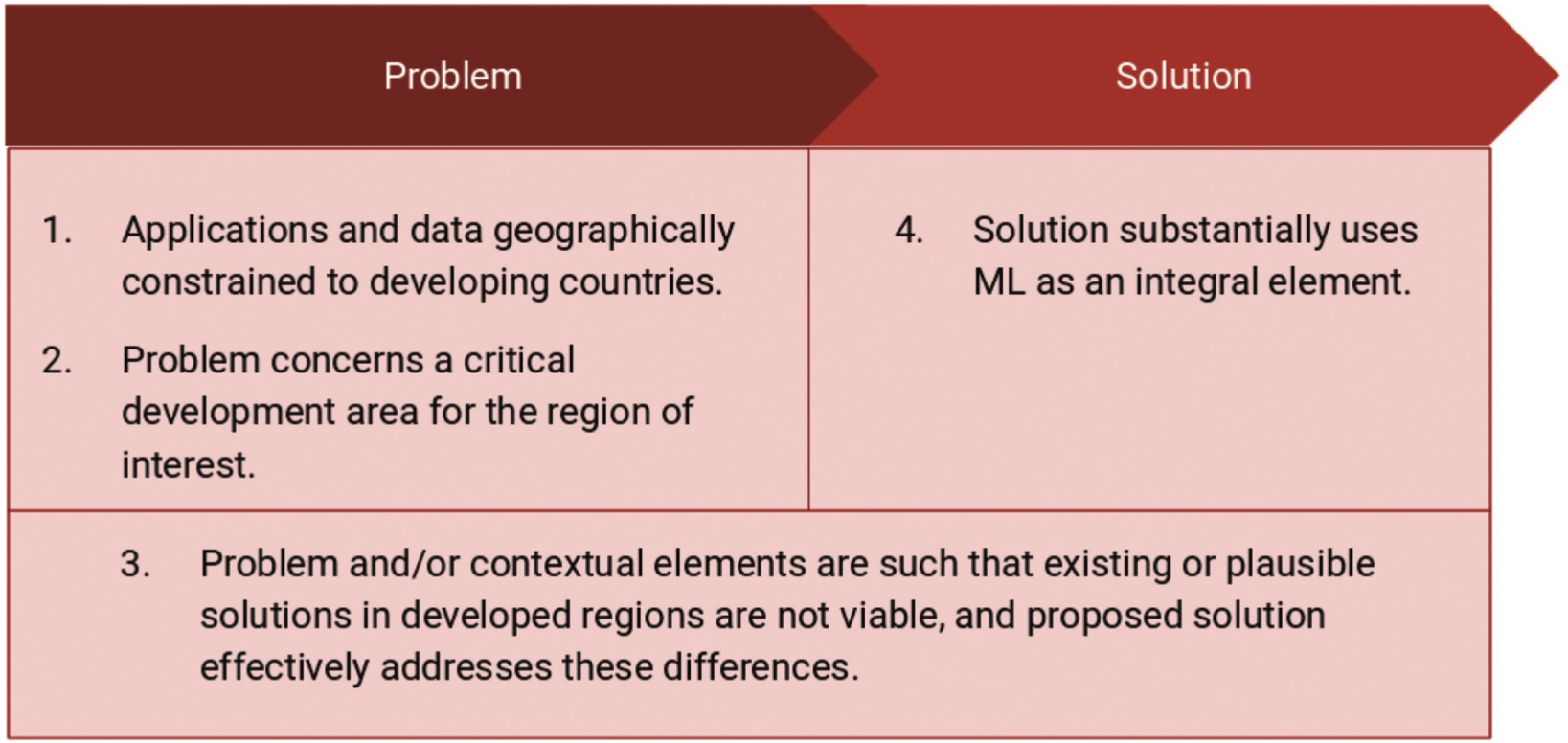
Learning Objectives

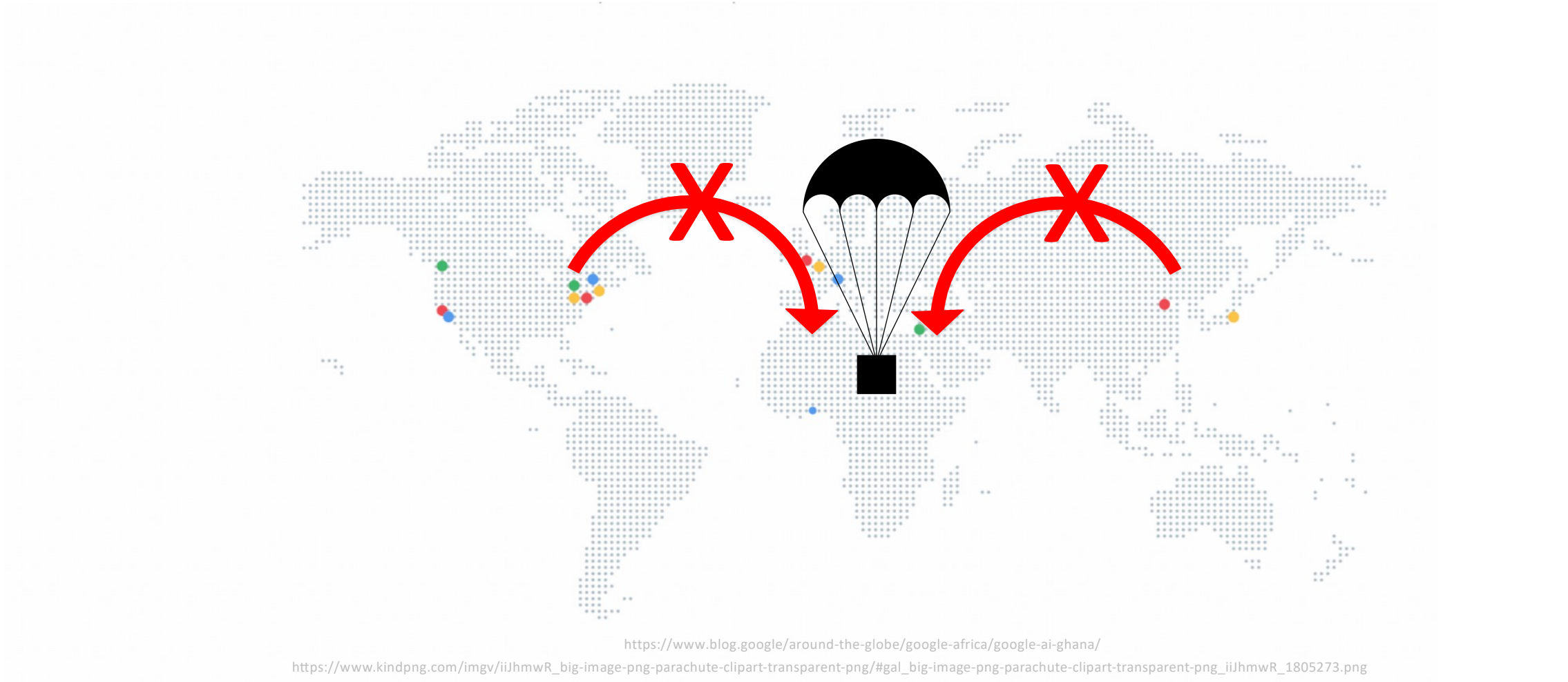
1. Define machine learning for the developing world (ML4D), differentiate it from traditional machine learning, and identify its four core attributes
2. Identify the five pillars of development
3. Explain the best practices for ensuring that ML4D projects are relevant
4. Explain a proposed roadmap for research in ML4D
5. Identify opportunities that ML4D affords for the development of the discipline of machine learning

Lecture Contents

1. Definition of machine learning for the developing world (ML4D)
2. Five pillars of development
3. The importance of local context in ML4D research
4. A road map for ML4D research
5. Opportunities for advancing machine learning through ML4D
6. Lecture summary
7. Recommended reading & references

Definition Machine Learning for the Developing World (ML4D)





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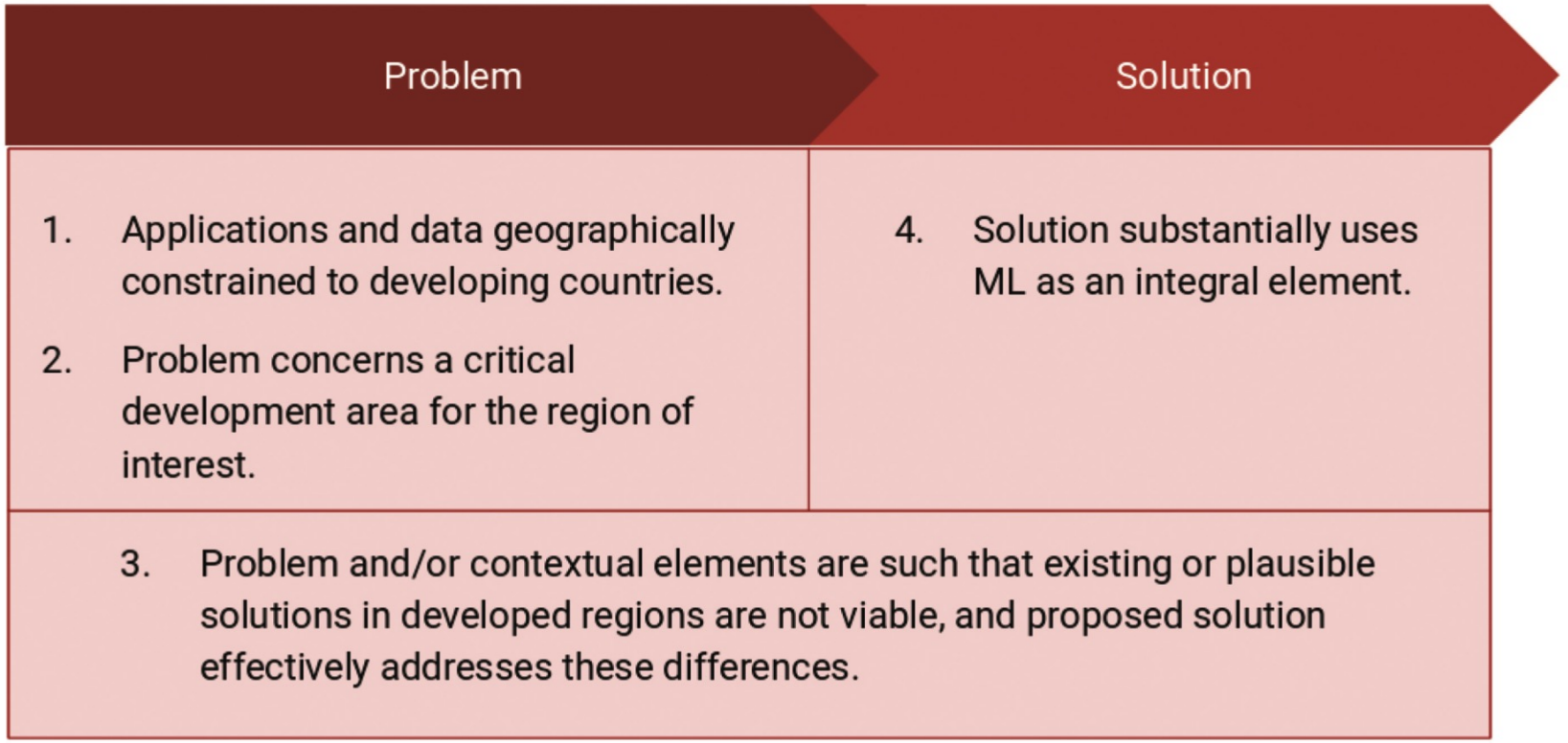

Five Pillars of Development

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Automated disease diagnosis in remote areas and urban hospitals

Anomaly detection to identify data-entry errors in medical records

Optimizing travel routes for health workers

Tracking infants using fingerprint technology to ensure they are getting the proper vaccinations

Early detection of outbreaks of disease

Five Pillars of Development

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Crisis mapping, providing analysis of violence, protests, or environmental disasters over time and across geographical regions

Predicting violence in urban environments

Detecting patterns of sexual violence

Detecting patterns of human rights violations

Assessing risk of fraud and collusion in international development contracts

Detecting electoral fraud

Five Pillars of Development

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Network analysis to understand how a country's products and exports impact their capability for future growth

Predicting default on cell phone debts

Predicting famine and poverty using satellite images

Detecting illegal mining activity using satellite images

Five Pillars of Development

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Resource allocation based on analysis of population mobility using cell phone data

Intelligent tutoring systems for low-cost, personalized education

Internet access using speech recognition and generation for communities that speak niche languages

Five Pillars of Development

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Study of flooding and landslides

Detection and prediction of seismic events

Analysis of land use and availability of agricultural land

Analysis of migration patterns of herders

The Importance of Local Context in ML4D Research

It is essential to consider the local context of a project to align

- Development needs
- Project's technological and institutional objectives

For example, if the goal is to inform policy,
the technical methodology should provide results that can be feasibly implemented

Results of a study of student needs that indicated 70% of students required interventions are of little use to schools that already have a shortage of teachers

The Importance of Local Context in ML4D Research

It is essential to take into account infrastructure constraints

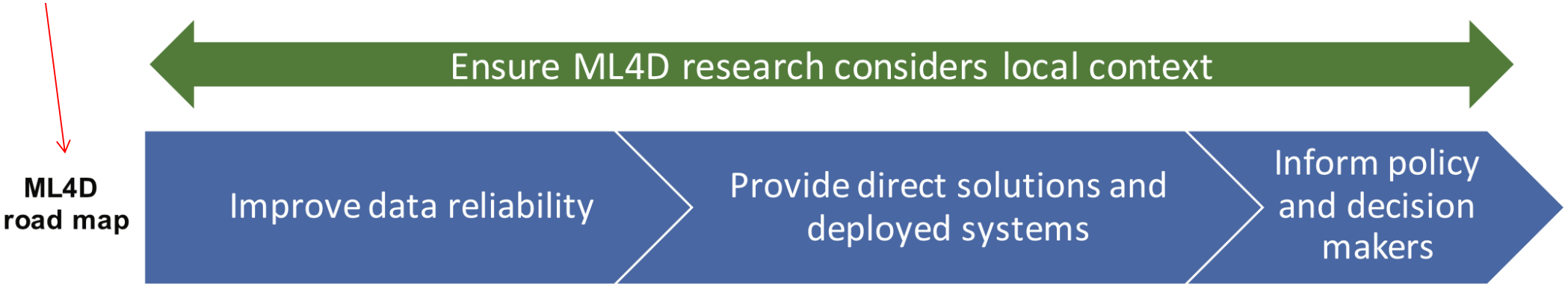
- Computational capacity
- Distance to repair shops
- Access to smart phones or feature phones

The Importance of Local Context in ML4D Research

- Machine learning allows computers to perform tasks that could previously only be achieved by highly skilled experts
- Consequently, machines can potentially perform jobs that are fundamental for society and difficult to fill currently
  - For example, augmenting and supporting human teachers
  - Help increase literacy and improve STEM skills
  - Facilitating development

A Road Map for ML4D research

Shows how ML4D can be used to foster development solutions



Opportunities for Advancing Machine Learning through ML4D

- The limitations and difficulties of successfully deploying ML technologies in the developing world are often highlighted

- Only true because the technology has been built assuming the conditions of developed countries

  - Current ML tools encode the infrastructure and cultural conditions of developed regions

  - No surprise if they don't work as well when these prerequisite assumptions are not valid, i.e., in developing regions

Opportunities for Advancing Machine Learning through ML4D

- Instead of thinking of these conditions as roadblocks stopping the successful deployment of ML …

- Think of them as research opportunities to advance ML by weakening or eliminating these assumptions

  - Poor data quality
    Research question: how can multiple incomplete, biased data sets be combined so that the bias is eliminated

  - Limited computing resources
    Research question: how can shared computers in a classroom be exploited in active learning

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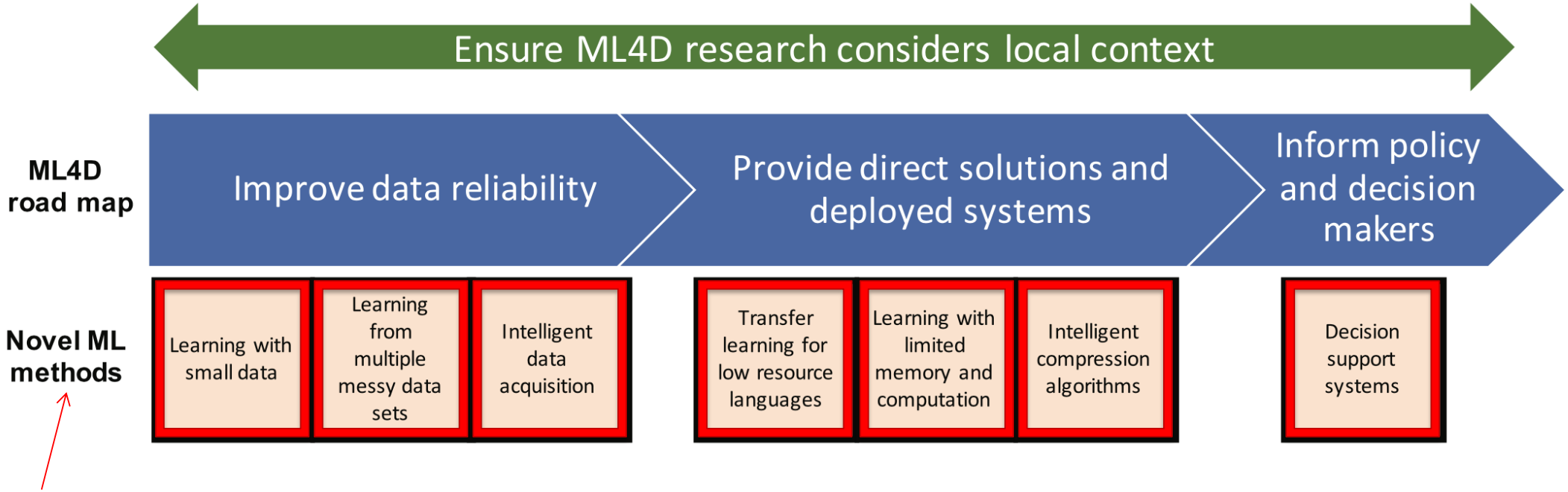

Areas of ML that can yield novel research motivated by ML4D

Lecture Summary

1. Machine Learning for the Developing World, or ML4D for short, is not simply the application of ML to developing world datasets

2. ML4D is grounded in the local context

3. There are five pillars of development: health, institutional, economic, social, and environment pillars, all of which can benefit from ML4D

4. ML4D doesn't necessarily involve the development of new techniques: the application of existing techniques in novel ways may often be appropriate

5. However, research motivated by ML4D in many areas of machine learning can yield novel results

Recommended Reading

De-Arteaga, M., Herlands, W., Neill, D. B. and Dubrawski, A. (2018). Machine Learning for the Developing World, Association for Computing Machinery, Vol. 9, No. 2, pp. 1-14.
https://www.ri.cmu.edu/wp-content/uploads/2020/05/3210548.pdf