# AI Applications for Developing Nepal

MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

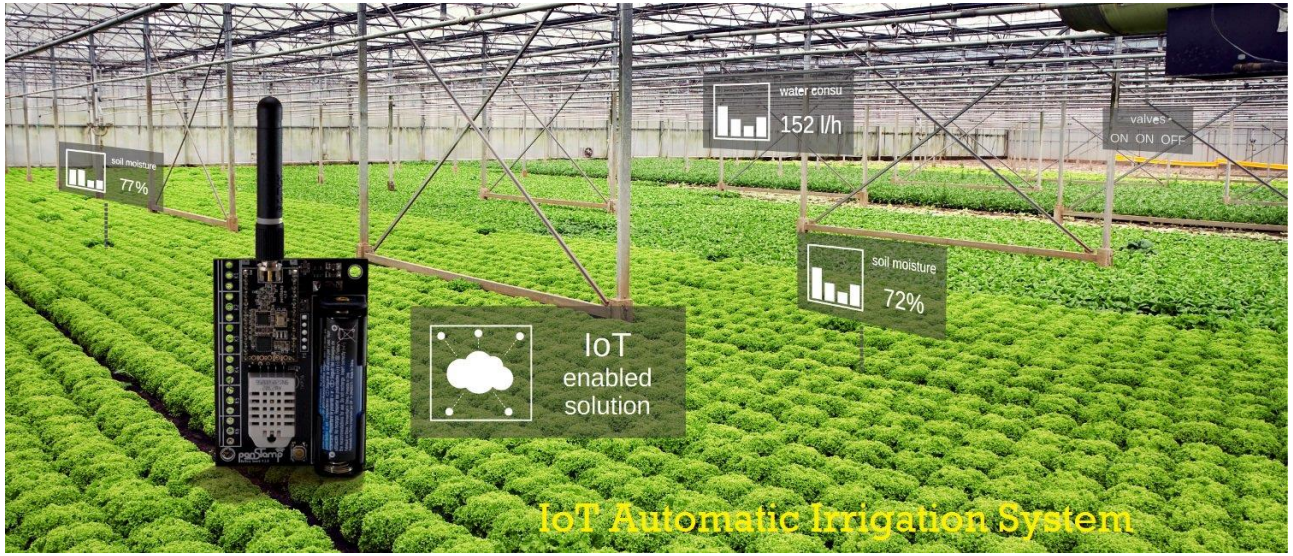
# AI applications for developing countries

- Efficient farming methods
- AI driven Medical Imaging and Healthcare
- Epidemic monitoring and management
- Workflow automation and Business Process Automation
- Resource allocation, Supply chain management and planning
- AI driven education

# Why AI is gaining prominence?

- Increased digitization means that there is huge amount of data available
- AI can learn human decision making and mimic this
- This in turn results in massive efficiency gains and better service delivery

# AI in Agriculture




IOT sensor integrating with monitoring

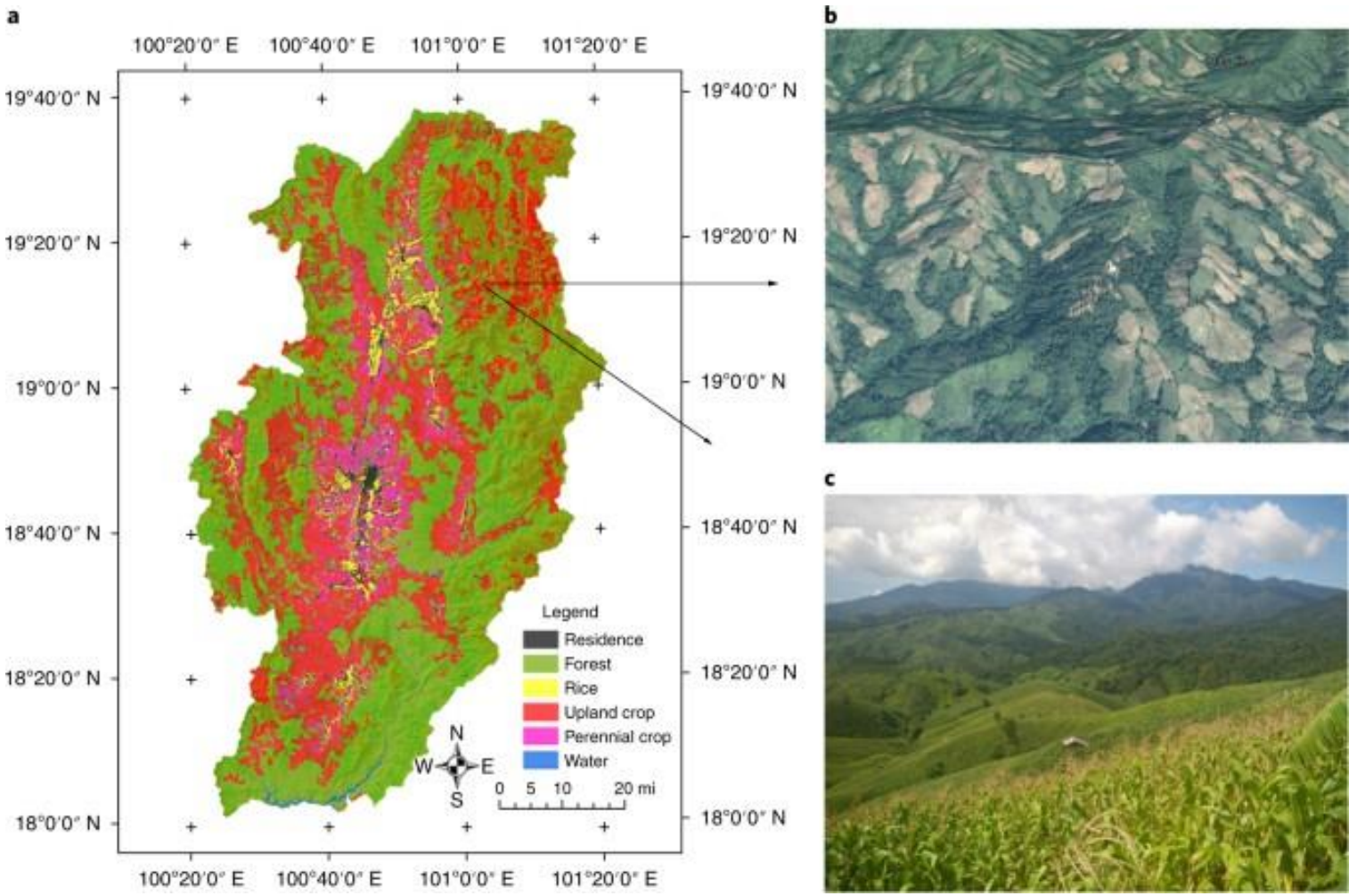
https://www.cropin.com/iot-internet-of-things-applications-agriculture/
https://www.mckensoftware.com/

# AI in Agriculture

Drone based monitoring and pesticide spreading

https://medium.com/@droni_tech/drones-are-revolutionizing-the-future-of-agriculture-farming-88eefd8091e
https://www.youtube.com/watch?v=P2YPG8P09JU

# AI in Agriculture

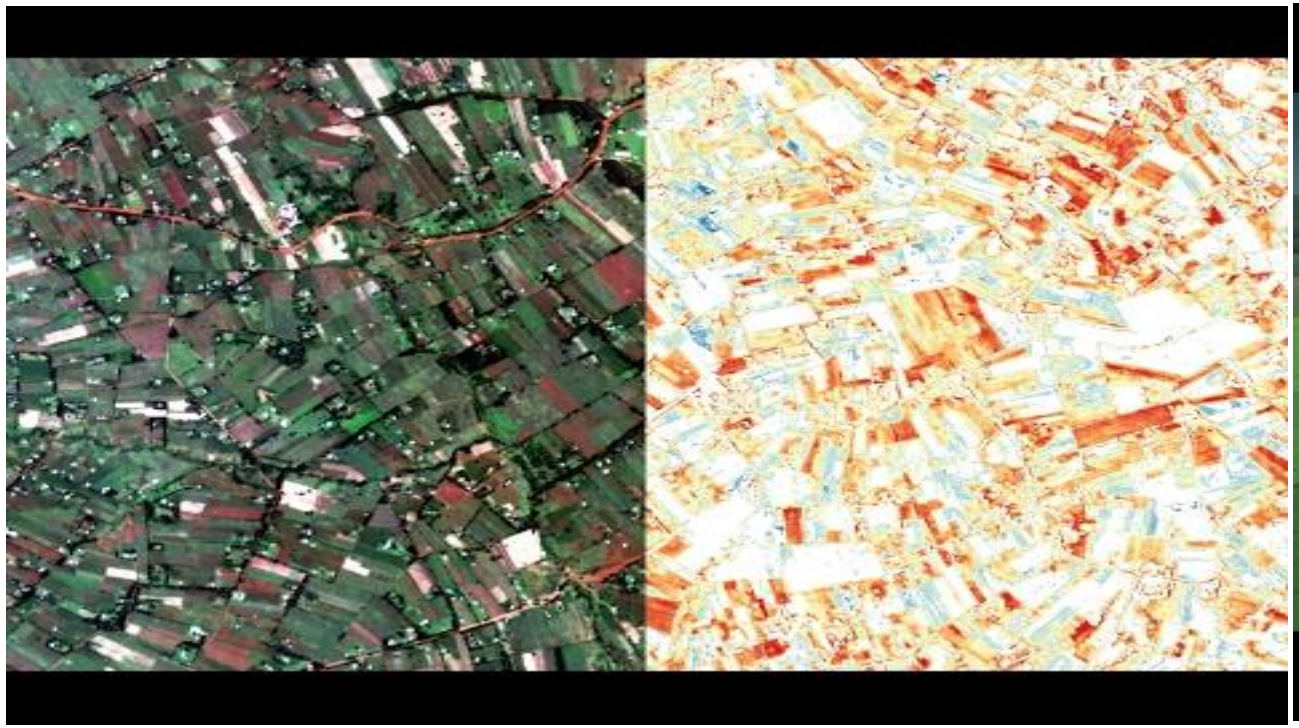



Satellite based large scale agriculture monitoring

https://www.nature.com/articles/s41561-018-0166-9

# AI for Government monitoring in Agriculture

- Using satellite data for:
  - Crop identification and yield forecasting
  - Disease spread monitoring
  - Land use monitoring
  - Water usage monitoring




https://www.youtube.com/watch?v=L19QxL1auj0&ab_channel=stanfordearth
https://www.youtube.com/watch?v=581Kx8wzTMc&ab_channel=Inter-AmericanDevelopmentBank

# Robotic agriculture

# Lost cost AI for Agriculture

- IoT Sensor integration with monitoring
- Plant disease detection using mobile phones
- Phone based services (e.g. Satellite based large scale agriculture monitoring)
- Low cost robotics

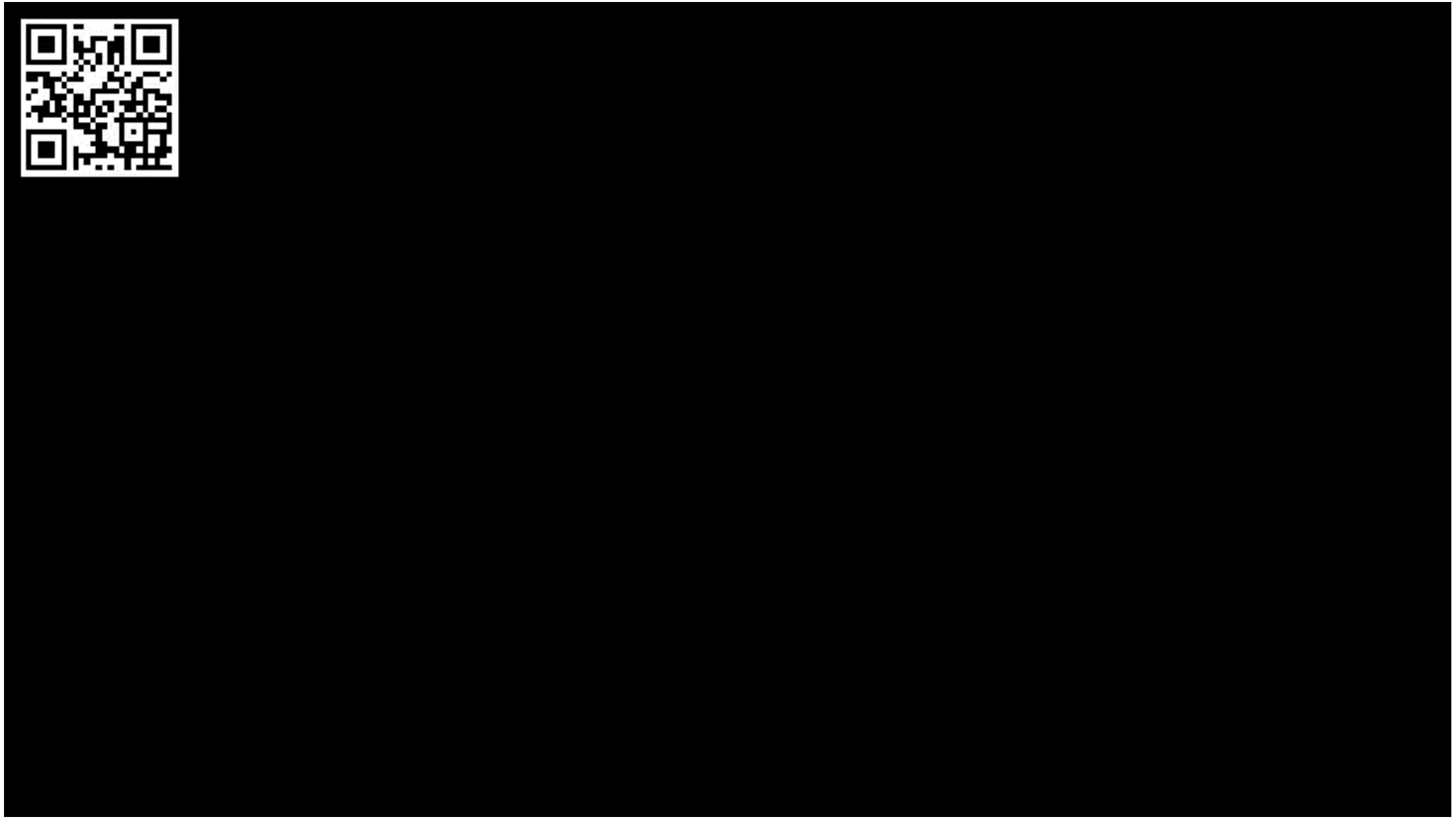
# Low cost AI for Agriculture


**Plant disease detection**

**Automatic weed detecting and killing**

https://www.blog.google/technology/ai/ai-takes-root-helping-farmers-identity-diseased-plants/
https://www.online-sciences.com/robotics/agricultural-robots-advantages-and-disadvantages/

# Low cost open source DIY precision farming



# The agriculture value chain

- Agro Chemicals
- Water
- Farm Equipment
- Agri Processing
- Government
- Agri Finance
- Farmer
- Retailer
- Supply Chain

# Optimizing the agriculture value chain

- Agro Chemicals
- Water
- Farm Equipment
- Agri Processing
- Government
- Agri Finance
- Farmer
- Retailer
- Supply Chain

Current State

- Precision chemical usage
- IoT & Weather driven usage
- Low cost robotic equipment
- AI imaging for sorting/packaging
- Optimal resource allocation
- AI driven credit risk scoring
- Agriculture analytics and profit estimation
- Demand forecast and pricing/profit
- Data fusion and analytics

Future State

# Challenges in healthcare delivery for all

- Healthcare data interoperability challenges
- Rural healthcare delivery
- Lack of medical experts
- Access to low cost quality healthcare
- Low cost medication
- Medical Insurance

# Healthcare data interoperability challenges

**US makes law data interoperability** March 2020

The U.S. Department of Health and Human Services (HHS) today finalized two transformative rules that will give patients unprecedented safe, secure access to their health data…..

“President Trump is delivering on his vision for healthcare that is affordable, personalized, and puts patients in control….”

“The days of patients being kept in the dark are over. In today’s digital age, our health system’s data sharing capacity shouldn’t be mired in the stone age. Unfortunately, data silos continue to fragment care, burden patients, and providers, and drive up costs through repeat tests. …. these rules begin a new chapter by requiring insurance plans to share health data with their patients in a format suitable for their phones or other device of their choice. …”

# AI technology for addressing data interoperability

- Most big data technology including healthcare is siloed
- Reason why the hype around big data has failed to deliver
- Data interoperability keeps patient in control of their own health records regardless of the health centre they visit
- Modern interoperability standards such as HL7/FHIR, OMAP use AI Knowledge Representation technology from the 80s
- Original vision of the WWW was also Semantic Interoperability – yet to be realised

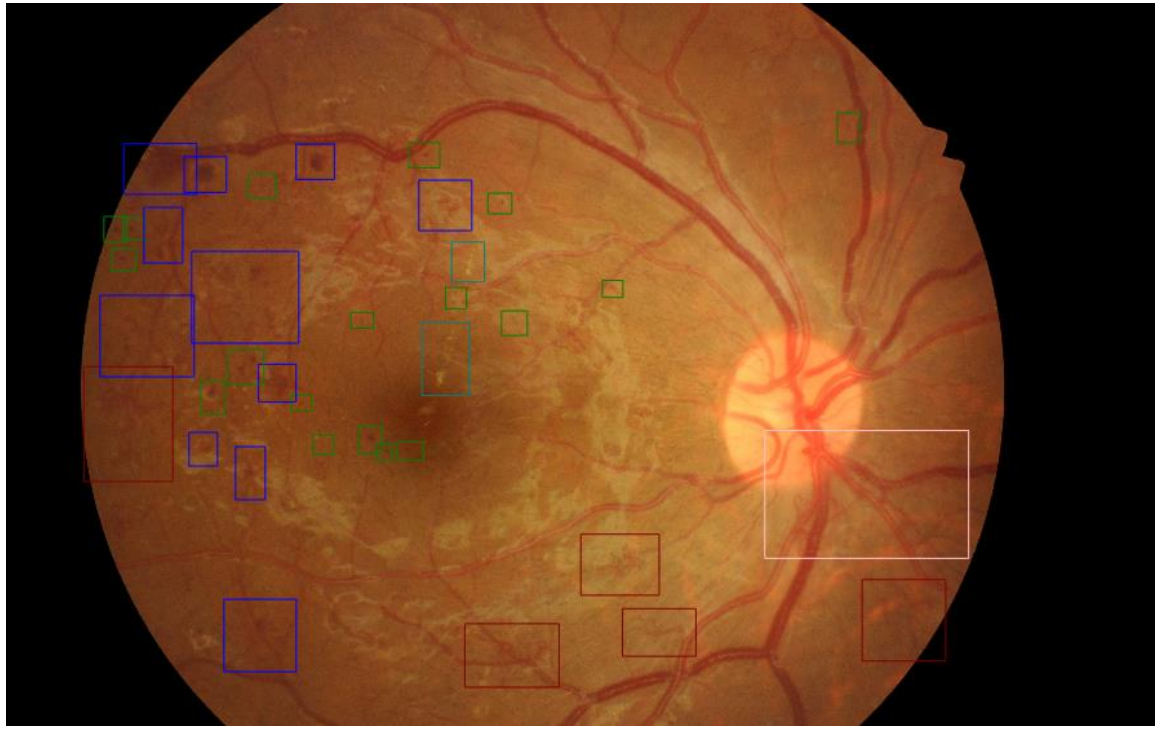
# Current challenges in Telemedicine delivery

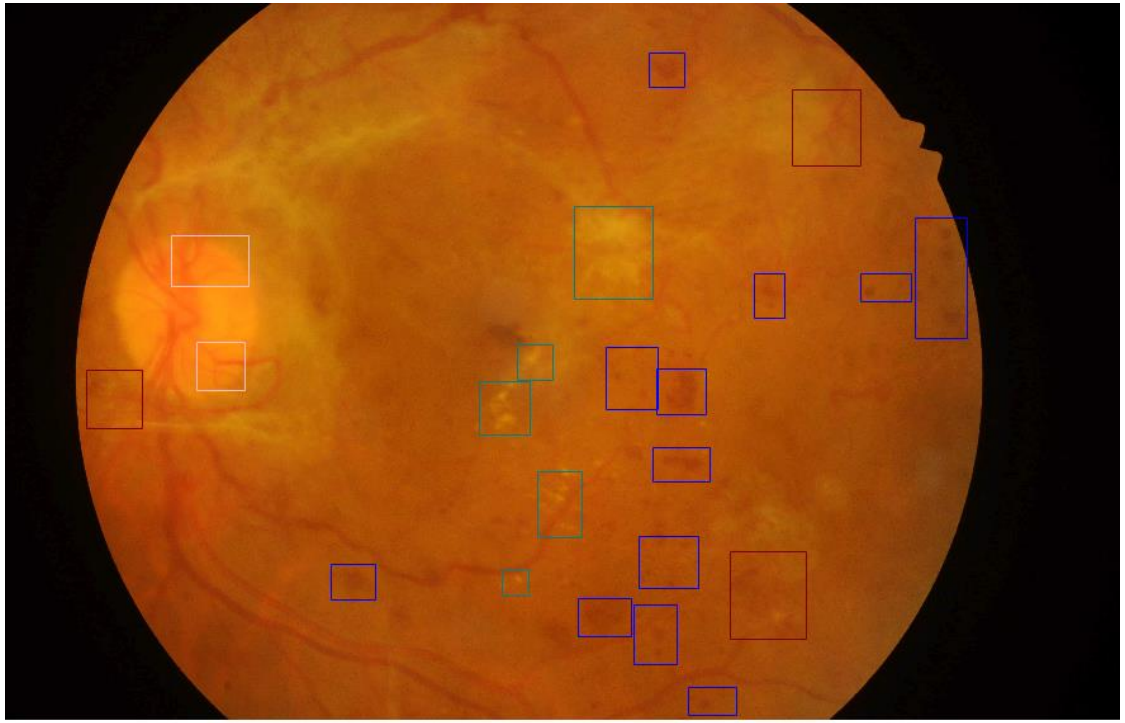
- Infrastructure Cost
- High speed internet

- Doctor patient synchronisation
- Travel time to telemedicine centre

# Mobile phone based AI for healthcare

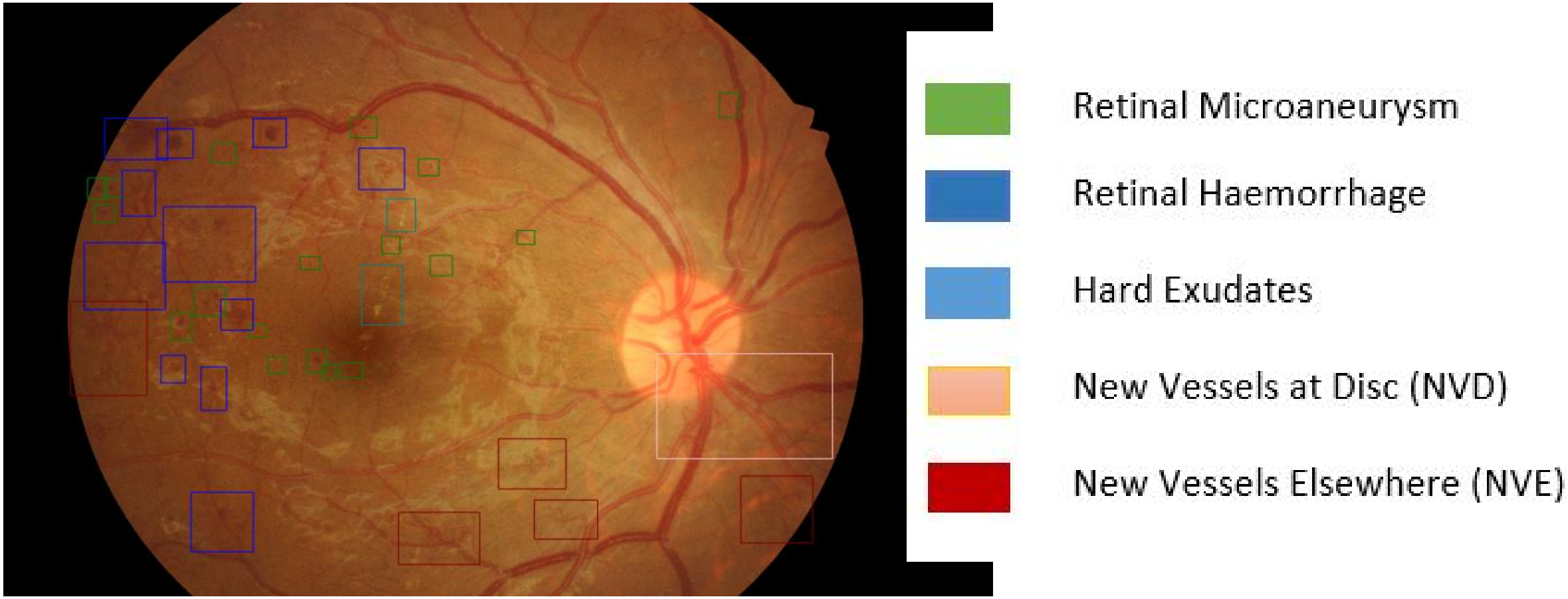
## Case: Diabetic retinopathy





- Aim: develop AI solution for automated diagnosis
- Provide instant diagnosis on the phone itself

# Case Study: Diabetic retinopathy

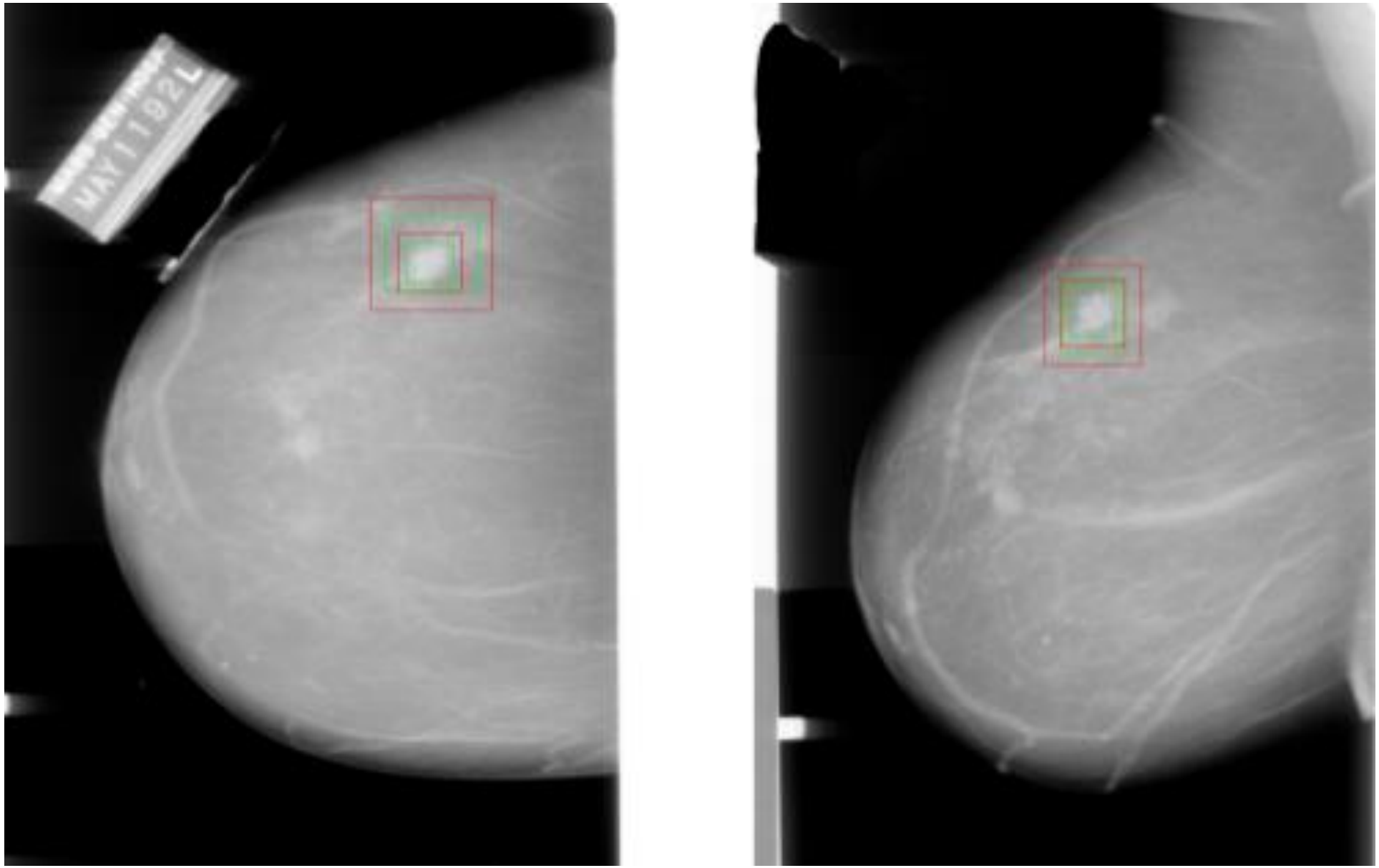



- Built on custom deep neural network architecture

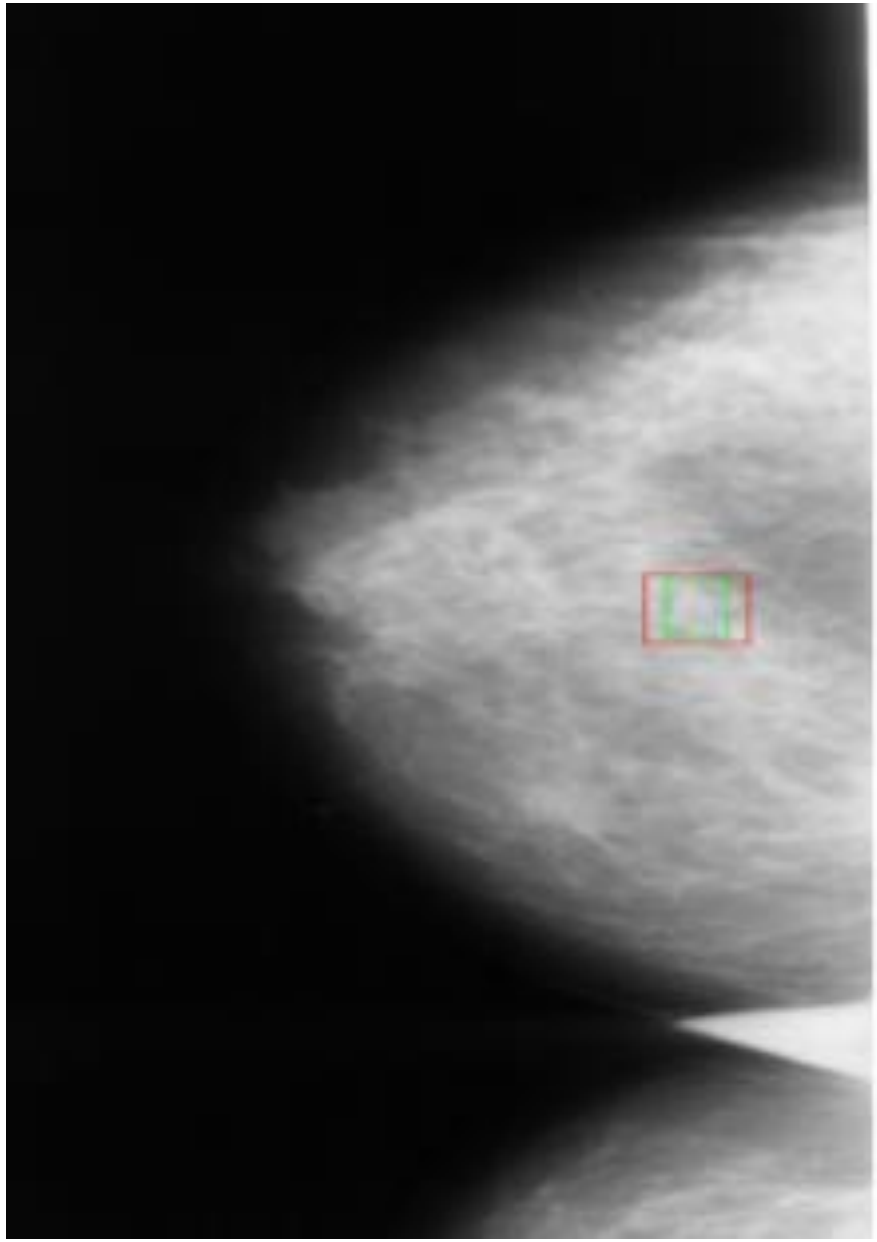
# Case Study: Diabetic retinopathy

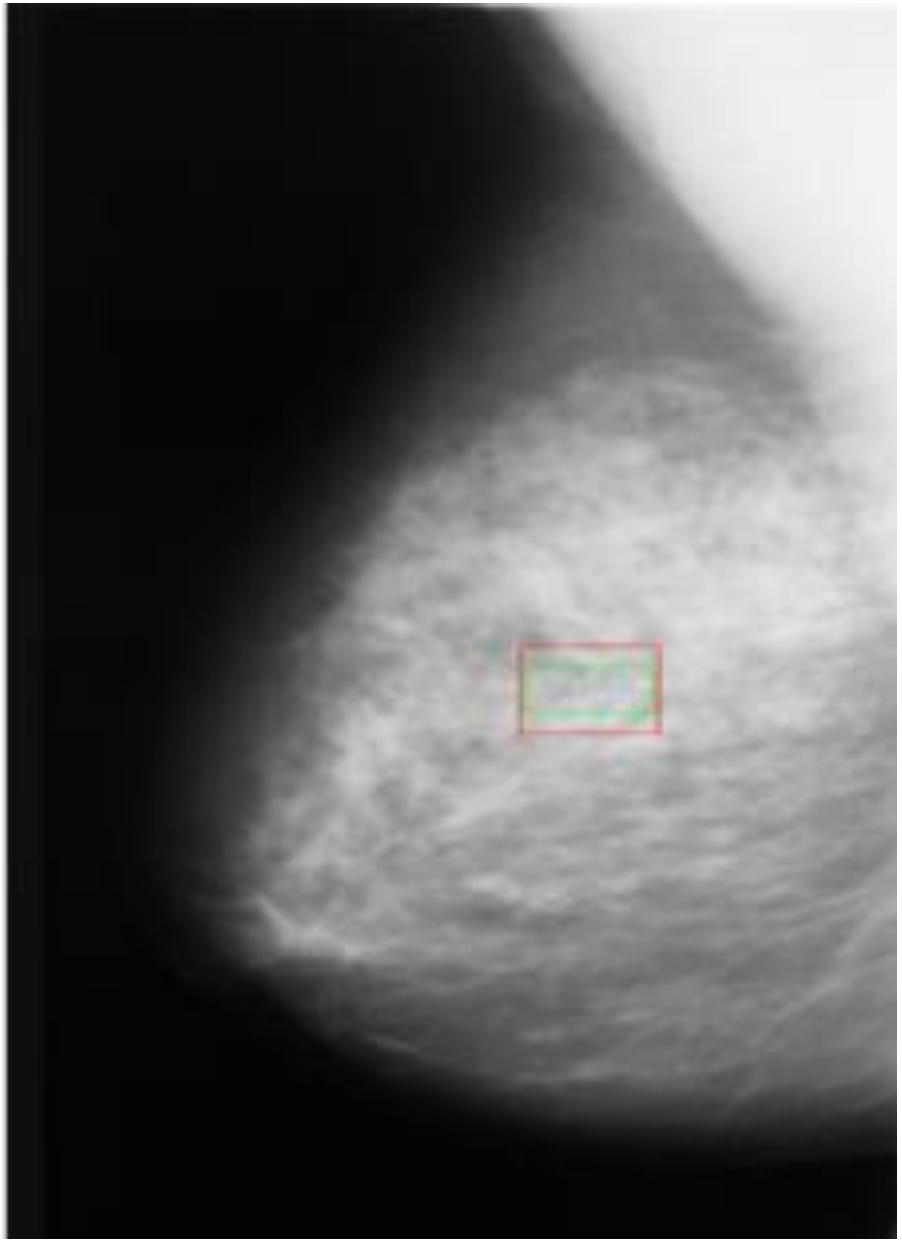
- Mobile phone based non mydriatic camera
- Attached to iphone
- Permits image capture and upload to server

# Case Study: Breast Cancer

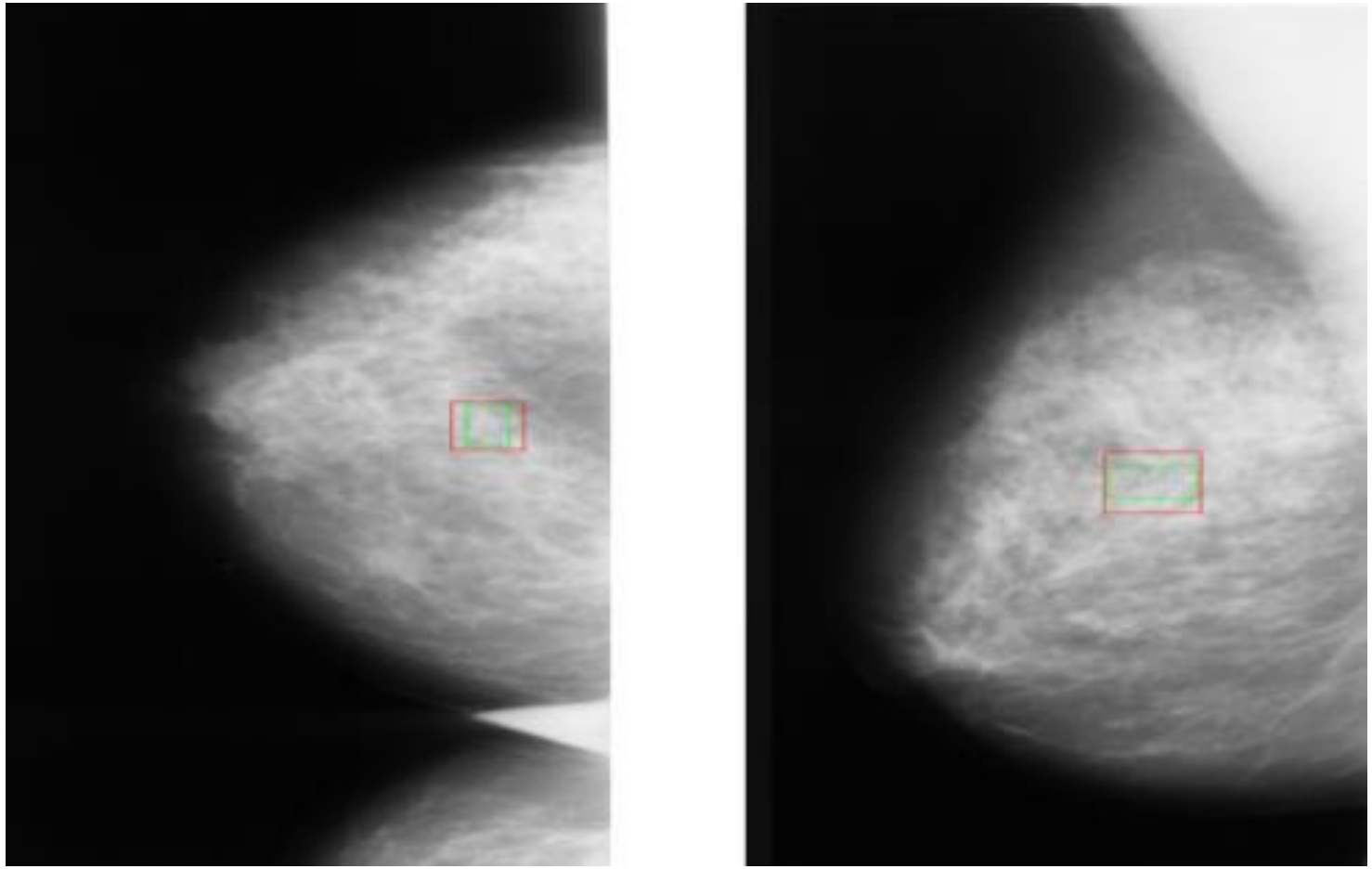


# Case Study: Breast Cancer



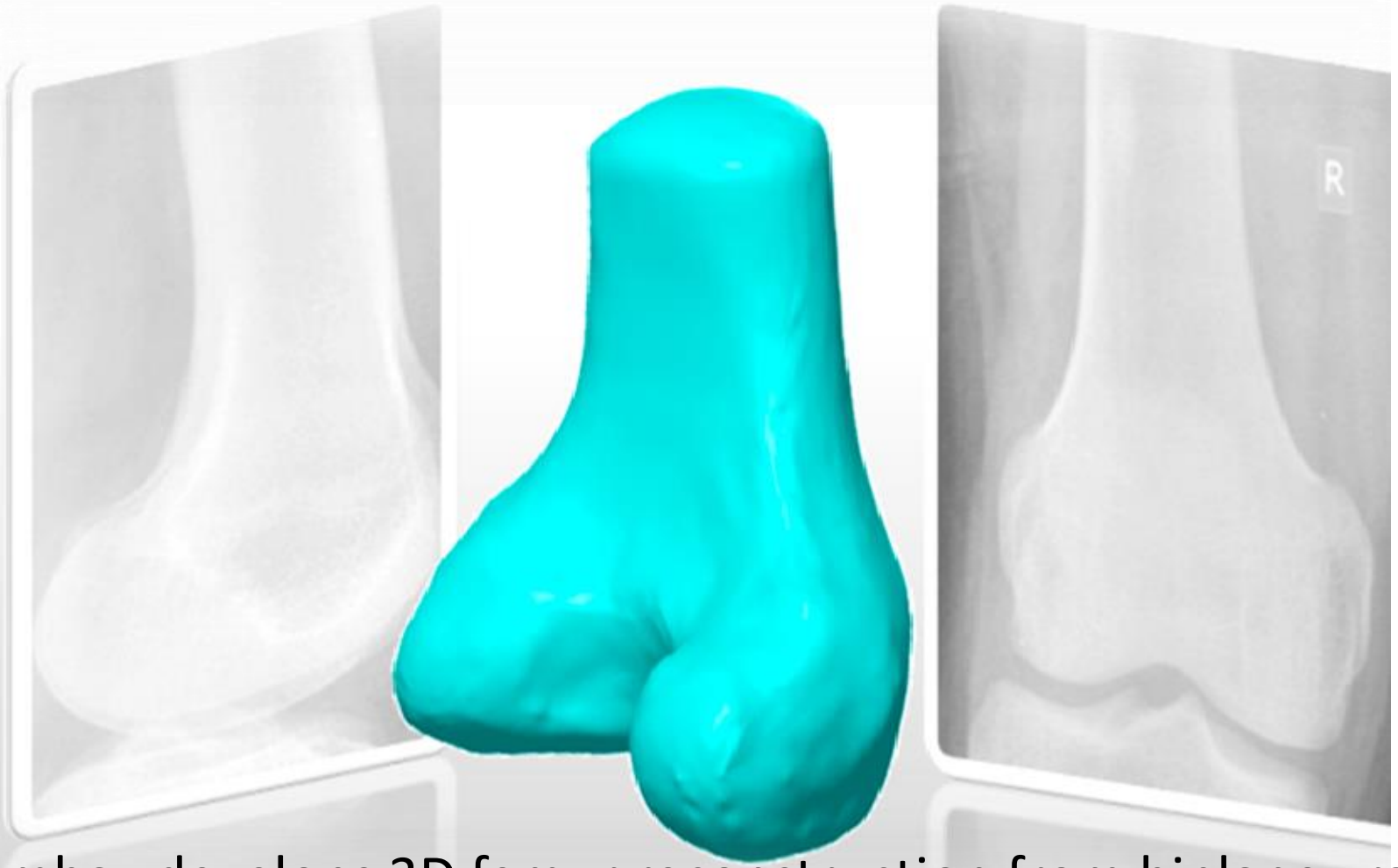


# Case Study: Breast Cancer



- Current AI diagnoses: *normal, benign-mass, malignant-mass, benign-calcification, malignant-calcification*
- Accuracy is close but less than expert but improving
- Ideal for remote diagnosis/training scenarios

# Case study: Low cost 3D reconstruction

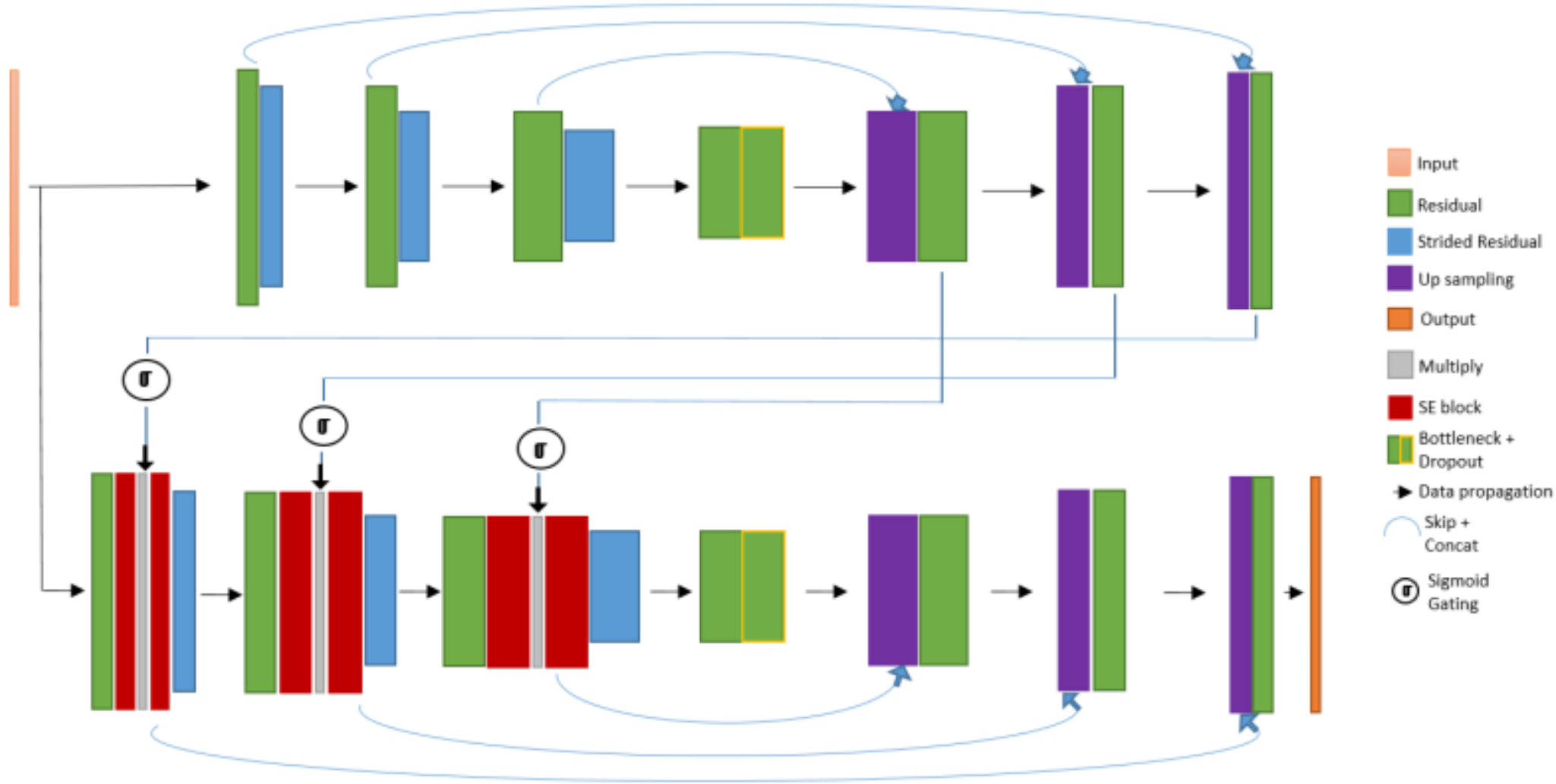



- IIT Bombay develops 3D femur reconstruction from biplane xrays

# Case study: Low cost digital pathology

- Low cost  USB connected microscopes are readily available
- Appropriate for remote health centre scenario

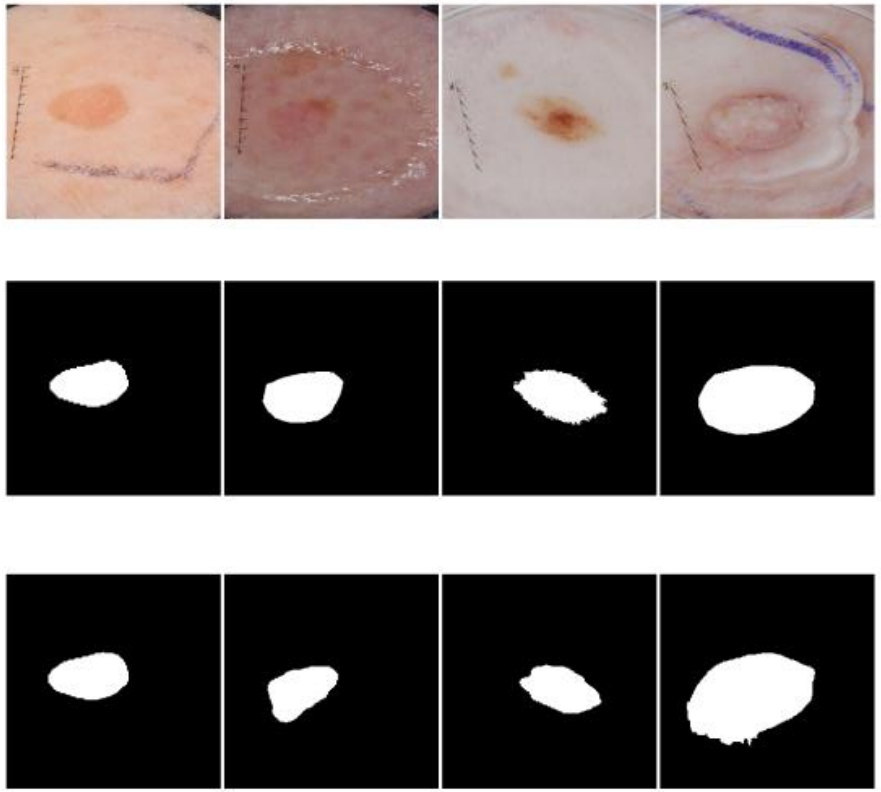
# General purpose image analysis : FocusNet Architecture




Chaitanya Kaul, Suresh Manandhar, Nick Pears. FocusNet: An attention based fully convolutional network for medical image segmentation. ISBI 2019

# State of the art results in image analysis for highly precise and effective AI driven diagnosis

## Melanoma Segmentation



Kaul, Chaitanya, Suresh Manandhar, and Nick Pears. "FocusNet: an attention based fully convolutional network for medical image segmentation." *2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019)*. IEEE, 2019.

## Melanoma Dataset

| Method | SE | SP | AC | JI | DI |
|---|---|---|---|---|---|
| FCN-8s [16] | 0.806 | 0.954 | 0.933 | 0.696 | 0.783 |
| U-Net [2] | 0.853 | 0.957 | 0.92 | 0.651 | 0.768 |
| II-FCN [17] | 0.841 | 0.984 | 0.929 | 0.699 | 0.794 |
| Auto-ED [18] | 0.836 | 0.966 | **0.936** | 0.738 | 0.824 |
| Thao *et al.* [19] | 0.6513 | 0.9421 | 0.8772 | 0.5065 | 0.6317 |
| LIN [16] | **0.855** | 0.974 | 0.934 | 0.753 | **0.839** |
| FocusNet (ours) | 0.7673 | **0.9896** | 0.9214 | **0.7562** | 0.8315 |

## Lung Cancer Dataset

| Method | SE | SP | AC | JI |
|---|---|---|---|---|
| U-Net [15] | 0.9696 | 0.9872 | 0.9828 | 0.9858 |
| Res-U-Net [15] | 0.9555 | 0.9945 | 0.9849 | 0.985 |
| RU-Net [15] | 0.9734 | 0.9866 | 0.9836 | 0.9836 |
| R2U-Net [15] | 0.9826 | 0.9918 | 0.9897 | 0.9897 |
| R2U-Net [15] | 0.9832 | 0.9944 | 0.9918 | 0.9918 |
| FocusNet (ours) | 0.9757 | 0.9981 | 0.9932 | 0.9965 |

# AI technology for Workflow automation and Document management

- Many office tasks are repetitive
- Often staff do not know what to do next
- You have a document jungle

**How can AI Help ?**

# AI and Blockchain together can provide solution

- Manual Repetitive tasks
- Often staff do not know what to do next
- You have a document jungle

# AI and Blockchain together can provide solution

- Manual Repetitive tasks
- What to do next ?
- Cannot find that document

Current State

- Automate repetitive tasks
- AI systems can learn from humans
- Office procedures can be automated using Blockchain and AI
- Automated AI driven document archiving can create semantic indexing of documents archives

Future State

# Challenges in current education delivery

- Availability of talented teachers in remote areas
- Difficult to address needs of individual students
- Seeking help from home may not possible
- Lack of internet
- Feedback on student progress is not immediate
- Lack of access to large pool of relevant teaching resources

# AI driven Education Delivery

- Modern AI systems can mark essays and even do simple mathematical proofs
- Automated assembling of Youtube videos and other teaching materials based on syllabus and student level
- Automated assistance when a student is stuck
- Chatbot systems for conversational assistance
- Automated prediction on grades based on current progress
- Offline availability for scaling to the masses

# Addressing multilinguality

- Nepal has 120+ languages and 250+ dialects (source: Wikipedia)
- … including language isolates (not belonging to any family)
- Need to preserve dying languages
- Building language driven services need to address voice recognition, voice synthesis, language translation, handwriting recognition

# Current Projects in Nepal in Language Processing

- Mixed language voice recognition e.g. Nepali, English, Hindi in same utterance
- Machine translation between languages of Nepal
- Optical Character and handwriting recognition
- Handwriting synthesis and style recognition
- Voice synthesis and style conversion

# MSc in Artificial Intelligence

## MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

# Generic structure for MSc in AI

## Semester 1

| Subject | Credits |
|---|---|
| Advanced Python Programming | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Machine Learning Theory - I | 2 |
| Subject Specialisation Theme 1 - I | 2 |
| Subject Specialisation Theme 2 - I | 2 |
| Research Methodology, Plagiarism, Ethics | 1 |

# Generic structure for MSc in AI

## Semester 2

| Subject | Credits |
|---|---|
| Deep Learning in Practice | 4 |
| Linear Algebra -- II | 2 |
| Probability Theory -- II | 2 |
| Machine Learning Theory - II | 2 |
| Subject Specialisation Theme 1 - II | 2 |
| Subject Specialisation Theme 2 - II | 2 |
| Paper reading and Presentation | 1 |

# Generic structure for MSc in AI

## Semester 3

| Subject | Credits |
|---|---|
| Advanced topics in Deep Learning | 4 |
| Bayesian Machine Learning | 4 |
| Subject Specialisation Theme 1 - III | 2 |
| Subject Specialisation Theme 2 - III | 2 |
| Mini Project | 3 |

# Generic structure for MSc in AI

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# Proposal for MSc in AI

## Semester 1

| Subject | Credits |
|---|---|
| Advanced Python Programming | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Machine Learning Theory - I | 2 |
| Natural Language Syntax | 2 |
| Image Processing Fundamentals | 2 |
| Research Methodology, Plagiarism, Ethics | 1 |

# Proposal for MSc in AI

## Semester 2

| Subject | Credits |
|---|---|
| Deep Learning in Practice | 4 |
| Linear Algebra -- II | 2 |
| Probability Theory -- II | 2 |
| Machine Learning Theory - II | 2 |
| Morphology and Parsing | 2 |
| Computer Vision Fundamentals | 2 |
| Paper reading and Presentation | 1 |

# Proposal for MSc in AI

## Semester 3

| Subject | Credits |
|---|---|
| Advanced topics in Deep Learning | 4 |
| Bayesian Machine Learning | 4 |
| Advanced topics in NLP | 2 |
| Advanced topics in Computer Vision | 2 |
| Mini Project | 3 |

# Proposal for MSc in AI

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# MSc in Artificial Intelligence with Specialisation

MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

# Generic structure for MSc in AI with Specialisation

## Semester 1

| Subject | Credits |
|---|---|
| Advanced Python Programming | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Machine Learning Theory - I | 2 |
| Subject Specialisation - I | 2 |
| Subject Specialisation - II | 2 |
| Research Methodology, Plagiarism, Ethics | 1 |

# Generic structure for MSc in AI with Specialisation

## Semester 2

| Subject | Credits |
|---|---|
| Deep Learning in Practice | 4 |
| Linear Algebra -- II | 2 |
| Probability Theory -- II | 2 |
| Machine Learning Theory - II | 2 |
| Subject Specialisation - III | 2 |
| Subject Specialisation - IV | 2 |
| Paper reading and Presentation | 1 |

# Generic structure for MSc in AI with Specialisation

## Semester 3

| Subject | Credits |
|---|---|
| Advanced topics in Deep Learning | 4 |
| Bayesian Machine Learning | 4 |
| Subject Specialisation - V | 4 |
| Mini Project | 3 |

# Generic structure for MSc in AI with Specialisation

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# Example: MSc in AI with Natural Language Processing Specialisation

## Semester 1

| Subject | Credits |
|---|---|
| Advanced Python Programming | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Machine Learning Theory - I | 2 |
| Natural Language Syntax | 2 |
| Language and Meaning | 2 |
| Research Methodology, Plagiarism, Ethics | 1 |

# Example: MSc in AI with Natural Language Processing Specialisation

## Semester 2

| Subject | Credits |
|---|---|
| Deep Learning in Practice | 4 |
| Linear Algebra -- II | 2 |
| Probability Theory -- II | 2 |
| Machine Learning Theory - II | 2 |
| Morphology and Parsing | 2 |
| Basic Deep Learning for NLP | 2 |
| Paper reading and Presentation | 1 |

# Example: MSc in AI with Natural Language Processing Specialisation

## Semester 3

| Subject | Credits |
|---|---|
| Advanced topics in Deep Learning | 4 |
| Bayesian Machine Learning | 4 |
| Advanced topics in NLP | 4 |
| Mini Project | 3 |

# Example: MSc in AI with Natural Language Processing Specialisation

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# MSc in Data Science with Specialisation

MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

# Generic structure for MSc in Data Science with Specialisation

## Semester 1

| Subject | Credits |
|---|---|
| Programming Principle using Python - I | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Data Preprocessing | 2 |
| Basic data visualisation methods | 2 |
| Subject Specialisation - I | 2 |
| Research Methods, Plagiarism, Ethics | 1 |

# Generic structure for MSc in Data Science with Specialisation

## Semester 2

| Subject | Credits |
|---|---|
| Python Programming | 4 |
| Statistical Methods for data science | 2 |
| Basics of predictive analytics | 2 |
| Introduction to AI and ML | 2 |
| Machine learning for data science | 2 |
| Subject Specialisation - II | 2 |
| Paper reading and Presentation | 1 |

# Generic structure for MSc in Data Science with Specialisation

## Semester 3

| Subject | Credits |
|---|---|
| Practical Deep Learning for data science | 4 |
| Subject Specialisation - III | 4 |
| Subject Specialisation - IV | 4 |
| Mini Project | 3 |

# Generic structure for MSc in Data Science with Specialisation

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# MSc in Data Science with Agriculture Specialisation

## Semester 1

| Subject | Credits |
|---|---|
| Programming Principle using Python - I | 4 |
| Linear Algebra -- I | 2 |
| Probability Theory -- I | 2 |
| Data Preprocessing | 2 |
| Basic data visualisation methods | 2 |
| Modern Agriculture methods | 2 |
| Research Methods, Plagiarism, Ethics | 1 |

# MSc in Data Science with Agriculture Specialisation

## Semester 2

| Subject | Credits |
|---|---|
| Python Programming | 4 |
| Statistical Methods for data science | 2 |
| Basics of predictive analytics | 2 |
| Introduction to AI and ML | 2 |
| Machine learning for data science | 2 |
| IoT sensing for farming | 2 |
| Paper reading and Presentation | 1 |

# MSc in Data Science with Agriculture Specialisation

## Semester 3

| Subject | Credits |
|---|---|
| Practical Deep Learning for data science | 4 |
| Modern farming principles | 4 |
| Data driven smart farming | 4 |
| Mini Project | 3 |

# MSc in Data Science with Agriculture Specialisation

## Semester 4

| Subject | Credits |
| --- | --- |
| Dissertation Project | 15 |

# MSc by Research Programs

## MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

# Generic structure for MSc by Research across disciplines

- Applicable to all taught MSc programs
- All taught MSc programs can potentially have a MSc by Research Programs
- The requirements for MSc by Research programs will be standardised across disciplines
- MSc by Research Structure:
  - Complete Taught MSc Program with a minimum GPA of 2.0
  - Complete additional 1 Year pure Research Project
  - The 1 year Research Project will run like a mini PhD program
  - The 1 year Research Project will expand on the dissertation project

# Research Degrees Program Structure

MADAN BHANDARI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Proposal by Suresh Manandhar

# Core aspects of Research degrees

- Research integrity and Ethics
- Supervisor(s)
- Thesis Advisory Board
- Progression points and success criteria
- Thesis Structure
- External courses
- External co-supervisors and collaborators
- Review of supervision and mitigation
- Teaching and Research Assistantships
- Publications
- Networking
- Seminars
- Conferences
- Nomination of External Examiner
- Viva
- Career paths and training
- Grant proposal writing and projects

# Research integrity and Ethics

- Every researcher needs to have full understanding of research ethics & research integrity
- Dual use nature of most scientific inventions
- Follow strict guidelines for academic conduct – referencing, acknowledgements, data ethics and privacy, laws governing experiments
- Understand academic misconduct and how to avoid this
- Ethical approval process – this needs to be designed and made available to all researchers
- Conscious or unconscious bias and how to avoid this
- Replicability of experimental results
- Reporting principles for scientifically validated reporting of experimental results

# Supervisor

- Supervisor(s) should be treated as peers of research students
- Build mutual trust and respect
- Allow students to challenge supervisor’s opinion
- Challenge student’s opinion while respecting their current knowledge
- Build a research team environment where student’s do not feel isolated
- Strive to turn a research student into a established independent and confident researcher
- Understand pressure on students to deliver and provide emotional support as needed

# Thesis Advisory Board

- **Responsibility**:
  - Provide broader research support to the research student and supervisor
  - Provide oversight in the progress of the research student
  - Provide networking help
  - Monitor research progress and validate progress against university procedures
  - Understand issues facing student and supervisor – assess research supervision
  - Suggest mechanisms for mitigation of issues
  - Advisory board members, excluding supervisor(s), cannot collaborate in the research project as this generates a conflict of interest
- **Meeting times:**
  - Meet at regular intervals at agreed times following University procedures
  - Be available for the student and supervisor when advisory assistance is neede
- **Membership:**
  - All members must be specialist within the broader subject area but not necessarily in the narrower research topic
  - All members need to be approved by the Graduate Research Chair in the respective department
  - Supervisor will fill in a nomination form provided by the University
  - MRes: Supervisor(s) + 1 additional Advisory Board member
  - PhD:  Supervisor(s) + at least 2 additional Advisory Board members

# Progression Points and success criteria (PhD)

## 1. Literature Review Report and Literature Review Seminar (Month 4)

**Literature Review Report should contain**:

- Critical review of literature within the chosen domain
- Clear identification of research gaps
- How this builds on MSc dissertation
- Identification of knowledge needed to conduct the research
- Identification of student and supervisor gaps in knowledge
- Identification of any training needs or external supervisor help

**Success criteria**:

- Review is critical, written in authoritative academic style, clearly identifies the current progress in the field
- Research gaps has been identified and clearly specified
- Comparison with MSc dissertation is provided and how new work merits a PhD is clearly identified.
- Does the student have the knowledge to carry out this research
- Does the supervisor have the knowledge to carry out this research
- If there is gap in required knowledge, has training needs and time required been clearly identified. Similarly, has external supervisor been clearly identified if needed.
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (MRes)

## 1. Literature Review Report and Literature Review Seminar (Month 2)

**Literature Review Report should contain**:

- Critical review of literature within the chosen domain
- Clear identification of research gaps
- How this builds on MSc dissertation
- Identification of knowledge needed to conduct the research

**Success criteria**:

- Review is critical, written in authoritative academic style, clearly identifies the current progress in the field
- Research gaps has been identified and clearly specified
- Comparison with MSc dissertation is provided and how new work merits a PhD is clearly identified.
- Does the student have the knowledge to carry out this research
- Does the supervisor have the knowledge to carry out this research
- For MRes, both supervisor and student need to have sufficient background to complete proposed research
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 2. Research Proposal Report and Research Proposal Seminar (Month 6)

**Research Proposal Report should contain**:

- Cleary defined research proposal that proposes to address a significant gap in current research within the chosen topic area
- Justification of why the proposed approach is going to be novel
- Justification of why the proposed approach is simply not incremental and would not be already published by other researchers
- Justification that the proposed research would represent a step change in enhancing our knowledge of the field
- Research Plan with milestones and timelines have been provided in a chart
- Clearly defined subjective and objective success criteria
- Identification of how the research will impact the field

**Success criteria**:

- Addressed research gaps is significant and not incremental
- Proposed approach is sufficiently novel and has potential to generalise over current approaches
- Success criteria for measuring success of the project has been clearly specified and meets currently used criteria within the field
- Research plan is realistic and achievable
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (MRes)

## 2. Research Proposal Report and Research Proposal Seminar (Month 3)

**Research Proposal Report should contain**:

- Cleary defined research proposal that proposes to address a significant gap in current research within the chosen topic area
- Justification of why the proposed approach is going to be novel
- Clearly defined subjective and objective success criteria
- Research Plan with milestones and timelines have been provided in a chart
- Identification of how the research will impact the field

**Success criteria**:

- Addressed research gaps are novel
- Proposed approach is sufficiently novel
- Research Plan is realistic and achievable
- Success criteria for measuring success of the project has been clearly specified and meets currently used criteria within the field
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 3. First Year Report and First Year Research Seminar (Month 12)

**First Year Report should contain**:

- Summary of Literature review
- Research Plan (including any agreed changes)
- Description of research milestones for the first year
- Report on the research carried out and results obtained against the set milestones
- Measurement of success/failure
- Publication plan
- Changes to the research plan and milestones resulting from the research

**Success criteria**:

- Has agreed research targets been achieved ?
- Are these research targets still significant taking into consideration new developments in the field ?
- Are changes to the research needed as a result? If yes, has these been provided with revised milestones and timelines? Are these achievable and still significant to merit a PhD degree?
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (MSc)

## 3. MSc by Research Thesis and Research Seminar (Month 12)

**Report should contain**:

- Critical Literature review
- Goals of the research
- Summary research objectives and milestones
- For each contribution Chapter:
  - Report on the research carried out and results obtained against the set milestones
  - Evaluation results
- Summary of research outcomes
- Publication plans

**Success criteria**:

- Has agreed research targets been achieved ?
- Does the results obtained merit a MSc by Research? If not what remedial measures need to be carried out. How much extra time will be needed. Can the MSc by Research
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 4. Second Year P1 Report and Second Year P1 Research Seminar (Month 18)

**Second Year P1 Report should contain**:

- Summary of Literature review
- Research Plan (including any agreed changes)
- Description of research milestones for Second Year P1
- Report on the research carried out and results obtained against the set milestones
- Measurement of success/failure
- Publication plan
- Changes to the research plan and milestones resulting from the research

**Success criteria**:

- Has agreed research targets been achieved ?
- Are these research targets still significant taking into consideration new developments in the field ?
- Are changes to the research needed as a result? If yes, has these been provided with revised milestones and timelines? Are these achievable and still significant to merit a PhD degree?
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 5. Second Year P2 Report and Second Year P2 Research Seminar (Month 24)

**Second Year P2 Report should contain**:

- Summary of Literature review
- Research Plan (including any agreed changes)
- Description of research milestones for Second Year P2
- Report on the research carried out and results obtained against the set milestones
- Measurement of success/failure
- Publication plan
- Changes to the research plan and milestones resulting from the research

**Success criteria**:

- Has agreed research targets been achieved ?
- Are these research targets still significant taking into consideration new developments in the field ?
- Are changes to the research needed as a result? If yes, has these been provided with revised milestones and timelines? Are these achievable and still significant to merit a PhD degree?
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 6. Third Year P1 Report and Third Year P1 Research Seminar (Month 30)

**Third Year P1 Report should contain**:

- Summary of Literature review
- Research Plan (including any agreed changes)
- Description of research milestones for Third Year P1
- Report on the research carried out and results obtained against the set milestones
- Measurement of success/failure
- Publication plan
- Changes to the research plan and milestones resulting from the research

**Success criteria**:

- Has agreed research targets been achieved ?
- Are these research targets still significant taking into consideration new developments in the field ?
- Are changes to the research needed as a result? If yes, has these been provided with revised milestones and timelines? Are these achievable and still significant to merit a PhD degree?
- Good delivery and answering questions raised during the seminar

# Progression Points and success criteria (PhD)

## 7. PhD Thesis Seminar (Month 35)

**PhD Thesis Seminar should contain**:

- Overview of research topic and research goals
- For each contribution Chapter:
  - Description of research carried out and results obtained
  - Evaluation against current state of the art
- Publications and Publication plan

**Success criteria**:

- Has agreed research targets been achieved ?
- Are these research targets still significant taking into consideration new developments in the field ?
- Does the research conducted merit a PhD?
- Good delivery and answering questions raised during the seminar

# PhD Thesis Structure

## 8. PhD Thesis Submission (Month 36)

**PhD Thesis Structure**:

- Overview of research topic and research goals
- Critical Literature Review
- For each contribution Chapter:
  - Description of research carried out and results obtained
  - Evaluation against current state of the art
- Summary and Conclusions

# External courses, co-supervisors and collaborators

## External courses

- The supervisor and student has the primary responsibility to identify external (online) courses needed to fill in any identified knowledge gaps
- These should be completed as early as possible during the PhD

## External co-supervisors and collaborators

- External co-supervisors and collaborators may be needed depending upon the research topic
- Having external co-supervisors and collaborators should be actively encouraged to build research partnerships both nationally and globally
- There needs to be a University policy document on such engagements
- The University needs to be supportive of such arrangement under some conditions:
  - Both supervisors can be co-supervisors
  - Can primary supervisors be external?
  - There should not be any financial incentives for external supervisors
- The University to initiate visiting faculty programs to encourage external links and collaborations

# Review of supervision and mitigation

## Review of supervision form

- This should be completed and provided to the Thesis Advisory Board members (excluding supervisor)
- Review of supervision will form part of the responsibility of the Thesis Advisory Board
- The student will have the right to keep the contents of the feedback confidential
- Any issues identified should be mitigated where possible
- With informed consent from the student, unresolvable issues will need to be brought to the attention of Departmental Graduate Research Chair

## Mitigation of issues and resolution

- Thesis Advisory Board members should aim to resolve any issues between supervisor and student where possible and suggest remedial measures. These could involve increased/decreased supervision, connecting with other students, emotional support etc.
- When mitigation is not possible, then the Graduate Research Chair will need to be informed who will initiate meeting with the student and the supervisor
- In extreme cases, Thesis Advisory Board can recommend change of supervisor or discontinuation of research degree

# Teaching and Research Assistantships

## Teaching Assistantships

- Students who have already completed their MSc and demonstrated competence in specific subjects should be encouraged to take up teaching assistantships
- Teaching assistants support running labs and assisting in classrooms
- Teaching assistants are not expected to teach
- Teaching assistants can also support some easy marking tasks while the responsibility of marking quality will rely solely on the lecturer/examiner

## Research Assistantships

- Research assistantships are generally only recommended for PhD students whose research topic aligns well with a research project.
- In such cases, the PhD thesis could be an outcome of the research project or directly supported by a research project.
- Since, doing is PhD is a full time activity, a PhD student cannot be involved in research that is not part of the PhD study.
- In all cases, departmental approval will be needed for PhD students to engage in any research projects.

# Publications

## Policy on publications

- All students are actively encouraged in publishing their research
- PhD students will be expected to publish their papers in established conferences and journals in their respective fields.
- Annual  Science Workshop:
  - The University will run an annual science workshop
  - The workshop will be annual event to celebrate the achievements of its staff and students
  - All research students will be required to present their work in Annual Science workshop that showcases research to businesses, government and other academics

## Mentoring scheme

- All students submitting posters or papers to the annual science workshop will be assigned an academic mentor
- The mentor will assist the student in improving the quality of the submitted paper
- Annual classes on paper writing will be provided

# Networking

- The University recognises that modern research is very often collaborative
- Collaboration is key for multidisciplinary and interdisciplinary research
- An open environment of idea sharing is essential to generate new research ideas
- Supervisors will be expected to link their students with collaborators both nationally and globally
- The University will conduct regular networking workshops on focussed interdisciplinary themes with the aim of generating grant applications or responding specific call for proposals

# Seminars and conference

## Seminars

- Students and faculty are expected to attend and present in seminars
- Each department will run a regular seminar series

## Conference

- All PhD students are expected to attend at least one conference to present their research during their PhD
- The University will need to provide funding pool for staff/student to present their work

## Summer School

- All PhD students are highly encouraged to attend summer/winter schools in their respective discipline as most of these are now available online
- The University will need to provide funding for students to attend such schools

# Nomination of External Examiner

## Procedure for nominating external examiner

- For research degrees, to maintain high research standards, it is critical to nominate external examiners that have substantial research experience and are leaders in their respective fields
- For this reason, the university will need to follow strict procedures for nominating external examiners
- Steps:
  - External examiners will be initially proposed by the Supervisor at least 3 months prior to thesis submission
  - Nominated external examiner will be vetted by a University Graduate Research Committee to ensure that the examiner meets the University requirements
  - The supervisor will contact the examiner to ensure that the examiner is willing to conduct the examination within a specified time limit
  - The University will contact the external examiner to initiate an external examiner form
  - Once the form is signed, the thesis will be sent to the external examiner

# Viva Procedure for PhD defense

## Conducting a viva

- PhD viva will be conducted in the presence of an external examiner and an internal examiner
- The internal examiner will typically be a member of the student's Thesis Advisory Board
- The external examiner will chair the viva session
- A viva can last from anywhere between 2 hrs to 6 hrs but most vivas are expected to take about 3 hrs
- The purpose of the viva is to ensure that the student:
  - has broad knowledge of the wider research area
  - has detailed knowledge of the specific research topic
  - can articulate clearly the contribution made within the subject area
  - is able to critically compare the research with the work of other researchers
  - can explain the rationale for the research undertaken and the results obtained
  - can defend the methods employed

# Career paths and training

## Career path beyond a PhD

- The purpose of a PhD program is not just to complete a PhD thesis but also to produce an independent researcher with a diverse set of skills that include:
  - good communication
  - ability to mentor others
  - team working
  - paper writing
  - teaching and course design
  - networking with others in the field
  - leadership in research and teaching
  - organising and running seminars
  - organising and running workshops
  - working with companies
  - grant writing
- To achieve the above objectives the University must take a holistic approach and put together structures and targeted activities to enable this transition

# Career paths and training

## Career path beyond a PhD

- All PhD students will be expected and encouraged to:
  - do regular seminar presentations within their department, other departments and within the community
  - work as TAs
  - assist in course design
  - mentor other PhDs
  - openly communicate new ideas in seminars and group meetings
  - organise internal seminars
  - organise or assist in organising workshops
  - engage in industrial/commercial projects where appropriate
  - initiate grant writing in the final year of PhD
- It will be the responsibility of the supervisor to actively mentor, connect and enable the PhD student towards achieving the above.

# Vision

- World class university vision – Why not?
- My past experience.
- Why I am back in Nepal
- AI as a service. The new excel
- Generate new research ideas focussing on multidisciplinarity
- Start working on this now
- What I am doing now
- Attract talented students and prevent brain drain.
- Attract new junior faculty