Autonomous, Multimodal, Edge

AI Technologies Transforming the Libraries

Libraries are poised for a paradigm shift !

Technology driven Evolution.. …

- Classification systems
- The printing revolution transformed access to knowledge.
- Microfilm digitization saved millions of fragile documents.
- The internet shifted catalogues, reference services, and repositories online.
- Digital libraries and open access altered the economics of academic communication.

AI Is the Defining Technology of our Time

Supercharges human capability

Transforms every domain

Solves high-complexity problems

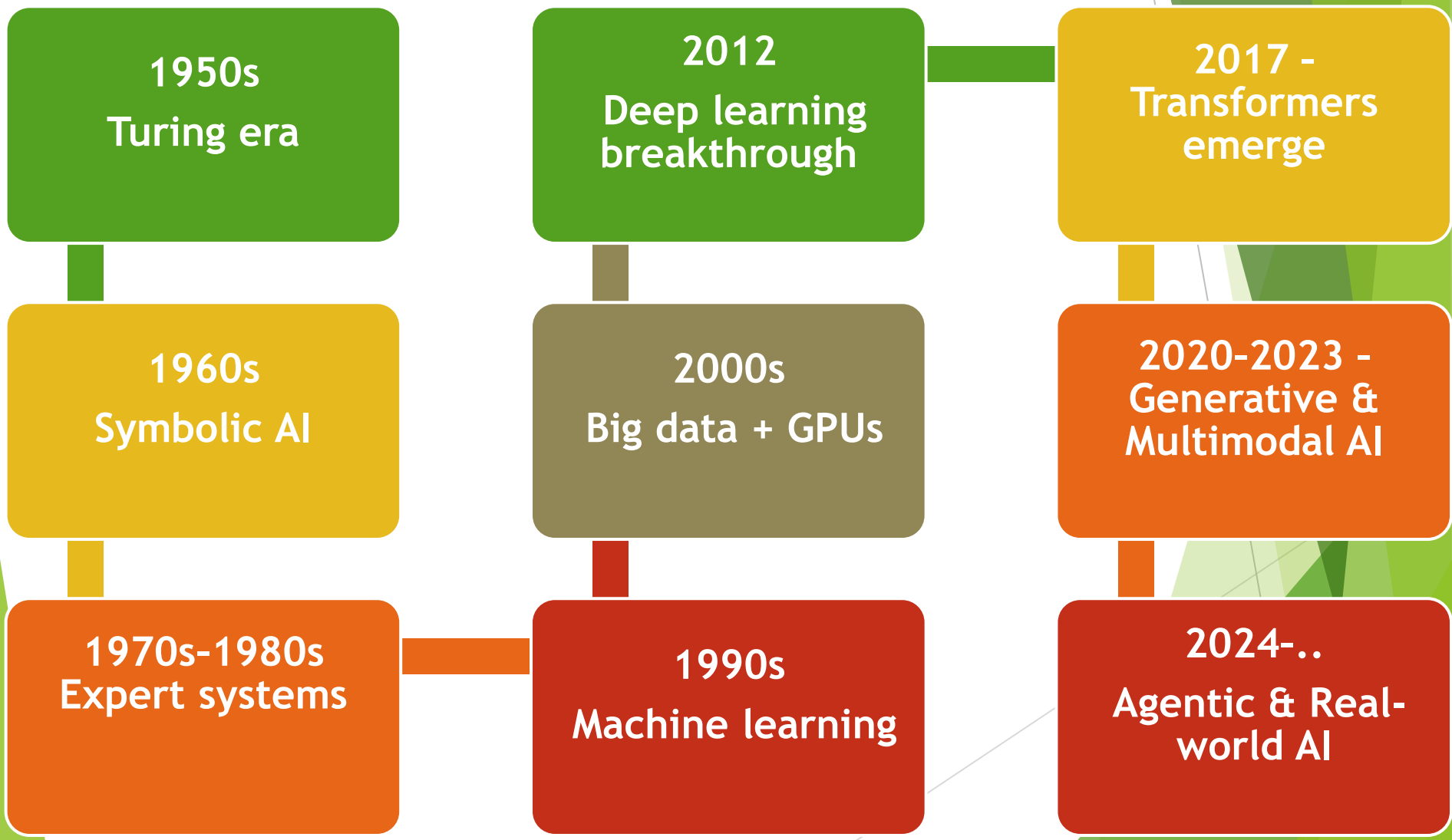
Accelerates breakthroughs in research

Enables Innovation & new systems

Scales globally instantly,

Reorders skills, productivity & security

Evolution of AI



AI in our Everyday Lives

- Phones & Assistants
- Search & Information
- Work & Productivity
- Health & Wellbeing
- Travel & Navigation
- Shopping & Payments
- Entertainment
- Smart Homes
- Social Media
- Public Services

Technologies enabling shift..

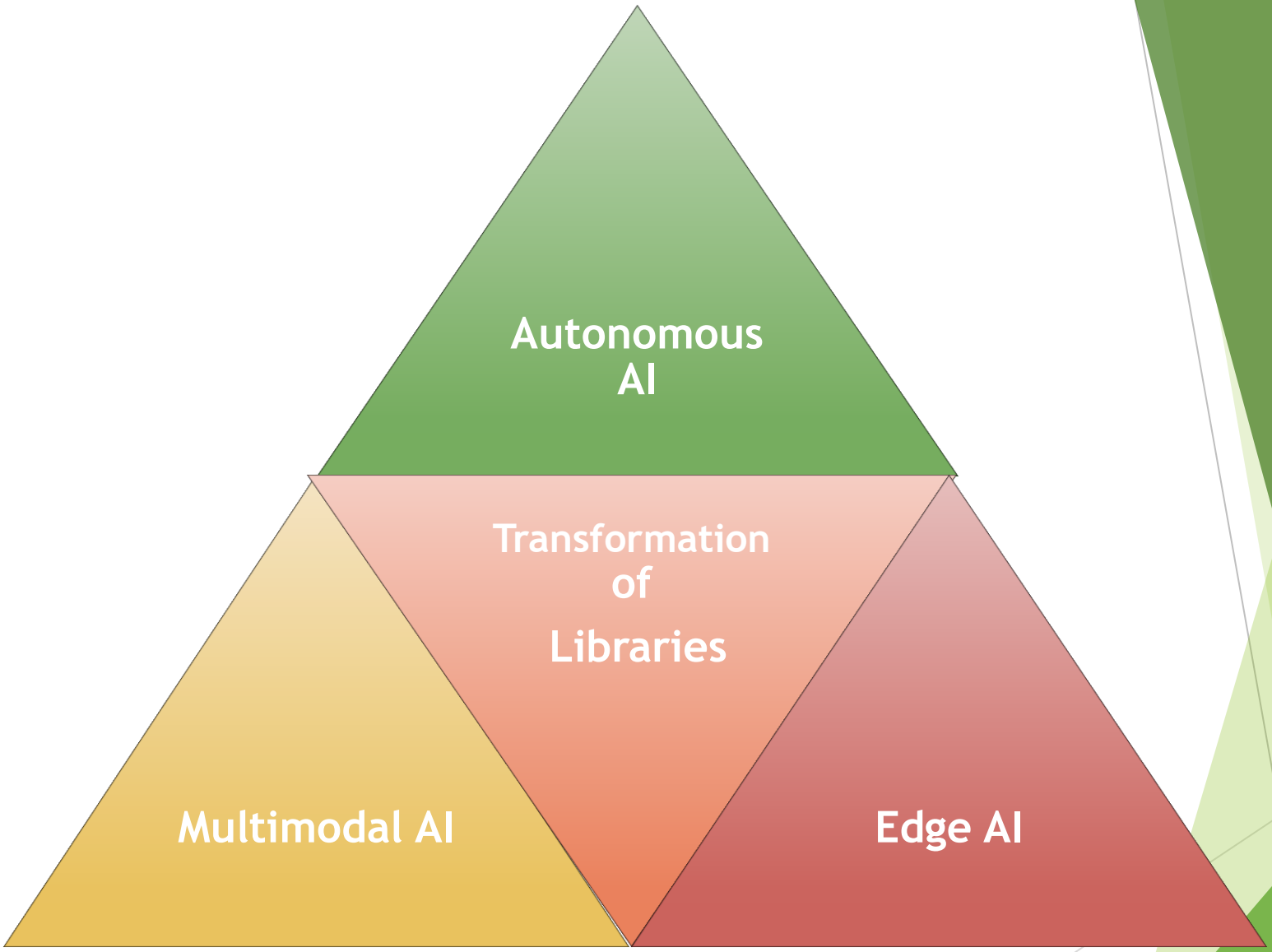
- Automated metadata and cataloguing at scale.
- Multimodal intelligence
- Personalisation of discovery and learning pathways.
- Real-time translation for multilingual access.
- Generative AI for summaries, guides, and learning support.
- Predictive analytics for smarter collection and space planning.
- Intelligent preservation through AI-enhanced digitisation.

Libraries at the threshold of reinvention !

AI has the potential to transform libraries into **autonomous knowledge universes—where information anticipates inquiry**, collections evolve continuously, and learning experiences are hyper-personalised, turning libraries into dynamic, intelligent hubs at the frontier of human curiosity and innovation.

Libraries must embrace AI to

stay relevant, resilient, and at the forefront of knowledge and learning in a changing world


Autonomous AI
Transformation of Libraries
Multimodal AI
Edge AI

AI Agents

- A system that performs tasks on behalf of a user using AI capabilities.
- **Acts with user prompts, rules, or workflows.**
- Needs **human direction**, periodic supervision, or predefined triggers.
- Examples :
  - Siri/Alexa responding when you ask.
  - Chatbot answering customer queries.
  - Food app filtering options when prompted.
- Reactive, task-based

Autonomous AI

- AI systems capable of **self-directed action**, making decisions, taking steps, and improving themselves with minimal human input.
- **Goal-driven, continuous, self-optimising behaviour.**
- Works **independently**, often across multiple tools and environments.
  - **Example:**
    - **Credit card system auto-blocking fraud.**
    - **Self-driving car making decisions continuously.**
    - **AC adjusting temperature by learning your routine.**

AI Agents as Digital Librarians…

Automated Metadata Creation

- Agents can extract subjects, keywords, summaries, emotions, themes, and references from documents
- This reduces cataloguing time and improves consistency.

Automated Acquisition and Licensing Monitoring

- Agents can scan publisher feeds, academic repositories, and rights databases,
- suggest relevant additions to the library, and flag expired licenses.

AI Agents as Digital Librarians

- **Autonomous Preservation Workflows**
  Agents can check **file integrity**, detect **format obsolescence**, trigger backups, and migrate materials to newer standards.

- **Reference Services**
  AI assistants can **handle first-level queries**: locating materials, interpreting catalogue entries, answering basic questions, and guiding users to the right resources. Librarians can focus on complex, contextual, or specialized research needs.

- **Research Support for Scholars**
  Agents can carry out literature scans, **map thematic evolution across decades**, highlight contradictions, and generate annotated bibliographies.

Agents as Partners, Not Replacements

- Autonomous Agents are not replacing librarians. They are expanding capacity.
  - Librarians provide judgment, ethics, empathy, and human context.
  - Agents provide speed, precision, and scale.

*The library of the future is a **human-machine partnership**, where librarians guide and shape the AI ecosystem, ensuring it remains aligned with values of equity, accuracy, and trust.*

Autonomous AI in Libraries

- National Library of Finland

  Automated Metadata Generation (uses AI model ANNIF)

- Singapore National Library Board

  AI-Powered Librarian Bot ("ASK Libby")

  ChatBook (Generative AI “Chat with a Book”)

  StoryGen (reimagine stories)

Multimodal AI

Multimodal AI

- Multimodal AI can read
  - text, images, audio, video, maps, diagrams, handwritten notes, datasets…..
- Multimodal AI can
  - extract themes from images,
  - convert handwriting into text,
  - transcribe videos,
  - generate subtitles, and

  Thus make every format searchable.

- Opportunity to digitize collections previously inaccessible:
  - archival photographs, sound recordings, microfilm, manuscripts, heritage objects, and video lectures.

Multimodal Catalogues

Instead of cataloguing a book solely by title, author, and subjects, AI can:

- generate a visual summary from page images
- extract diagrams and classify them
- index spoken words from audiobooks
- tag themes from video content
- convert images into searchable text
- detect geographical references
- measure sentiment or complexity

A single AI-driven workflow can create rich, layered metadata that previously required multiple teams.

Multimodal AI : Making Non-Text Resources Discoverable & Accessible

- A library could allow a **student** to upload a picture of a historical site and retrieve matching archival images.
- A **visually impaired** user could convert any handwritten document into audio description.
- An **art historian** could analyze thousands of paintings for stylistic features in minutes.
- A **researcher** could search across videos for every instance where a particular concept is mentioned.

Multimodal AI in Libraries

- **Library of Congress (LC)**

  Newspaper Navigator is a **machine-learning tool** developed by LC Labs to make visual content in historic newspapers **searchable**.

  It covers **16+ million pages** of newspapers from the *Chronicling America* project, spanning from 1789 to 1963.

  The project extracts **7 types** of visual content: photographs, illustrations, maps, comics, editorial cartoons, headlines & ads.

- **National Library of Australia – Trove Multimodal Discovery**
  - A single search portal that brings together more than 14 billion digital items from Australian libraries, universities, museums, archives, galleries, and community collections.
  - Includes newspapers, books, magazines, journals, photographs, letters, maps, government gazettes, music, videos, and more.

Europeana — Multimodal Cultural Heritage

- Europeana aggregates digital **collections from 3,700+** museums, libraries, archives and galleries across Europe into one searchable platform
- Hosts over **50 million digitised items** — books, artworks, manuscripts, films, photographs, newspapers, 3D objects, and more.

National Library of Norway

- Norway is digitizing *every book, newspaper, image, and audio recording* ever produced in the country.
- Norway is the **first country in the world** to digitize an entire national knowledge collection and make it searchable through multimodal AI.

Edge AI:
Speed, Privacy and Local Intelligence

Edge AI

- Edge AI means running AI models **locally**, on:
  - tablets
  - mobile phones
  - library computers
  - kiosks
  - digital signage
  - embedded devices in the library
  - IoT sensors
  - offline rural networks

- No cloud dependence. No latency. No large-scale data sharing.

Why Edge AI Matters for Libraries

- **Privacy-Preserving Services**
  A user can ask sensitive questions—health, legal, financial—without sending data to any server.

- **Low-Bandwidth Environments**
  Rural, remote, or underserved communities can get full AI capability without requiring high-speed internet.

- **Fast, Real-Time Interactions**
  Think of reading suggestions, translation tools, or navigation assistance inside the library—instantly, on-device.

- **Secure Digital Preservation**
  AI tools that analyze and preserve local collections without exposing them to external networks.

Edge AI in Libraries

Libraries across India, Kenya, Japan, and Canada are using offline AI devices for community learning and multilingual access, ensuring equitable access for all populations.

Application of AI in Libraries

AI for Metadata, Classification, & Knowledge Graphs

- AI can generate **enriched metadata** automatically: themes, entities, dates, geolocations, topics, reading levels, and summaries.
- Beyond metadata, AI builds **knowledge graphs** connecting people, events, timelines, concepts, and archives.
- Libraries globally are piloting such systems to create dynamic, interconnected knowledge ecosystems.

AI for Content Generation & Accessibility

- Libraries can use AI to **generate educational materials**: summaries, abstracts, learning modules, visual explanations, and multilingual translations.
- AI can create s**imple versions of complex texts**, generate alternative formats for persons with disabilities, and create voice narration instantly.
- This transforms libraries into **content creation hubs** for teachers, students, and community groups.
- **AI-powered learning aids** help children, senior citizens, and new learners engage with information more effectively, expanding the **library's societal impact**.

Trust, Verification & Authenticity

- **~402.74 million terabytes of data** are generated worldwide **each day**, That amounts to roughly **147 zettabytes per year**
- **Deepfakes** are rising rapidly in volume and are increasingly causing real harm
- Misinformation is another challenge
- As deepfakes and misinformation rise, libraries will play a central role in:
  - verifying digital materials
  - providing provenance information
  - watermarking digitized assets

Personalized Learning & Reading Journeys

- AI also allows hyper-personalized reading and learning experiences:
  - adaptive reading lists based on interests
  - personalised difficulty levels for students
  - contextual recommendations based on prior searches
  - reading plans for competitive exams
  - accessible learning pathways for neurodiverse users

Libraries become engines of equity, empowering each individual on their own terms.

AI enablement of a Library

- strong ethical frameworks, governance, data policies, and clear human oversight.
- need new skills : digital literacy, prompt engineering, metadata engineering, and AI ethics.
- Infrastructure gaps must be addressed
- Privacy protections must remain central

The transition requires investment, training, governance, and community participation.

Thankyou for your kind attention

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