

Springer Series on Cultural Computing

Tula Giannini  
Jonathan P. Bowen *Editors*

# The Arts and Computational Culture: Real and Virtual Worlds

 Springer

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Tula Giannini · Jonathan P. Bowen  
Editors

# The Arts and Computational Culture: Real and Virtual Worlds

 Springer

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Paul Brown, *Dragon*, 2012. Kinetic Painting: Realtime Computational and Generative Artwork. Size and orientation variable. This work was commissioned for the Intuition and Ingenuity exhibition that celebrated the Alan Turing centenary and was influenced by his later work on morphogenesis. (Copyright © Paul Brown, 2012/2023. Used with permission)

# Foreword

I am an artist and writer who has been involved in the algorithmic arts since the 1960s when I saw Jasia Reichardt's exhibition *Cybernetic Serendipity* at London's Institute for Contemporary Art. My contribution to the field was recognized in 2018 by the Cultural Programs of the National Academy of Sciences who invited me to show a retrospective of my work as a part of their 50th anniversary celebrations of that exhibition. In 1989, the Australia Council for the Arts awarded me a two-year Media Arts Fellowship, and in 2023, I received the ACM/SIGGRAPH Distinguished Artist of the Year Award for Lifetime Achievement in Digital Art.

Back in 1953, when I was six years old, we moved from a small two-room stone cottage high on the Yorkshire moors (which didn't even have electricity) to a three-bedroom house in suburban Manchester. It had an inside toilet, a bathroom, hot running water, and many other mod-cons we of the developed world take for granted. It also had a telephone which lived in a window alcove in the hallway. It was a big Bakelite affair anchored to the wall by a woven, twisted-pair cable, and I was forbidden to touch it unless there was an emergency. Today, seventy years later, I have an iPhone 13. It can be used almost anywhere and connects me, almost instantaneously, to the world's knowledge as well as its many dubious untruths. It boasts a camera which is significantly better than any I have owned before. I can use it to take photographs of natural phenomena (aka cute little kittens) to post immediately to Facebook for the delight of all. How the mighty computer has changed our world!

In the mid-1990s, I undertook a consultancy on behalf of the Australia Council for the Arts and Museums Australia investigating the way that small regional museums in Northern Queensland could benefit from the then-new World Wide Web. These are often voluntary organizations that only open a couple of days each week. Curators expressed their concern that putting their collections online together with their opening times could provide a 'shopping list' for the global criminal community. Around the same time an Egyptologist showed me a sample of grave cloth from a Pharaonic tomb and indicated the dust and pollen it contained. This dust provides essential additional information about how and where the fabric was made and stored—something that is missing from the simple pictorial record. This problem, of semiosis—the relationship between the signifier web object and the signified 'real'

object—is a problem that underlies the verisimilitude and value of the representation. For the casual visitor the image may be sufficient, but the serious researcher requires richer, multidimensional data.

Russell Kirsch, who pioneered image digitization in the mid-1950s (see illustration overleaf), once told me that a complete digital record of an oil painting would require 15 dimensions in addition to the 2D pixel array. Kirsch and his art historian partner Joan also pioneered the computational approach to esthetic analysis and creativity—their 1988 *Leonardo* journal paper *The Anatomy of Painting Style: Description with Computer Rules* is here: <https://www.jstor.org/stable/1578708>.

In their first book in this series, the editors addressed the role of museums in adopting the WWW and digital technology. Here, in this current volume, they make the transition to what they call computational culture. When explaining terms like this to people I like to compare the ‘computer-aided’ to the ‘computational’ paradigm. Computer-aided solutions are typical of first-generation adoption of digital technology. Professionals take what they know and automate it: accountants automate triple entry bookkeeping (and create massive amounts of redundancy along the way). Architects and engineers take traditional drafting techniques to make computer-aided design (CAD) applications that mimic the old ways of doing things. Despite their limitations, these metaphorical tools increase productivity, and the technology becomes widely adopted.

In 1990, I gave a talk to a group of undergraduate students at one of Australia’s pre-eminent Engineering Schools. I encouraged them to get involved with the computer revolution, not just by using these tools but also by learning how to build and develop new ones of their own. I warned them that the time would come when they may not be employable without these skills. After I had finished a tenured professor, who had seniority, stood up and counseled the students to ignore my predictions. ‘Don’t throw away your slide rules and technical pens just yet’, he advised. ‘These computers are just the latest fad’.

Fortunately, the dinosaurs have retired, and a second generation has emerged who are no longer anchored in the pre-computer idiom. They are developing new tools that make use of the unique opportunities offered by what Alan Kay called the computational meta-medium with its embedded artificial intelligence (AI), artificial life (A-Life), and immersive interfaces. Web3 beckons, no longer a metaphor for the printed page or TV channel, but a whole new way of engaging with other intelligences—both real and artificial. For example, the buildings of Zaha Hadid—and many other contemporary architects—would be impossible to conceptualize, visualize, or build without this new generation of computational creative assistants.

This collection of essays explores this new paradigm: its history, development, the new methods that are emerging, and their possible futures. As the digital process evolves from being a tool into a creative collaborator, this is a welcome and timely text.





Russell Kirsch, Portrait of his son Walden at three months, 1957. Original image  $179 \times 179$  pixels. The first digital scan was produced using a rotating drum scanner invented by NIST (<https://www.nist.gov/mathematics-statistics/first-digital-image>). (Used with permission. National Institute of Standards and Technology, rights reserved)

Ocean Shores, New South Wales,  
Australia  
2023

Paul Brown  
2023 ACM SIGGRAPH Distinguished  
Artist, Award for Lifetime  
Achievement in Digital Art

# Preface

Fueled by the convergence of computational culture colliding with sweeping social and cultural change, the arts are experiencing a revolutionary moment poised to transform art and life as we know it on a global scale. Sparking intense excitement and investment is the promise of the Metaverse, a new place in cyberspace, a 3D internet, that extends reality, building immersive virtual worlds on internet platforms and networks, enabling human-to-human interaction (HHI) with a user-centric approach in a 360-degree immersive interaction environment, a sharp contrast to humans looking at 2D flat screens. With computational culture, for the first time, reality, and virtuality merge, integrated by new developments in artificial intelligence (AI) and machine learning (ML), materialized by emerging technologies from virtual reality (VR) to augmented reality (AR) while extended reality (XR) makes us feel more than human, offering artists of all stripes new digital ways of making art, telling stories, and engaging participants and audiences. *The Arts and Computational Culture: Real and Virtual Worlds* is among the first books to address the context, complexity, and impact of this multi-faceted subject in vivid detail aiming for up close and personal engagement of the reader while evoking a landscape view.

Tectonic shifts in information technology that brought us digital culture at the end of the 20th century changed the way we communicate and use information while creating an explosion of born-digital and digitized documents and objects. Yet our way of life from work to home and travel remained essentially in place, whereas with the emergence of computational culture, our life, identity, work, and play are rapidly becoming embedded in advanced computer systems summoning AI and ML in conjunction with the latest technologies capable of simulating human senses and tracking our digital identity. For the first time, human intelligence is being challenged by artificial intelligence in ways that will impact academic disciplines, professions, and industry systems using algorithms to break down silos. This interconnectedness of life across the globe is having dramatic effects on the arts from tools and technologies to social and cultural values and ethics, making computational culture both inspirational and disruptive.

From digital to computational culture, the focus shifts from hierarchical institutional systems and control to artists and their work connected to the global internet

environment, teeming with human experience and interaction across all digital media. Facilitated by computing, artificial intelligence, machine learning, algorithms, and simulated human senses, the arts are expanding their horizons across all facets of human life and experience. Artists have new tools and new spaces to engage the public from the internet and across many digital venues, real and virtual to galleries and museums, shopping malls, public squares, and education. Big tech's recent focus and massive investments in building the Metaverse depend on working with digital artists to design new spaces and places and platforms that bring virtual worlds to life. In this moment of computational culture surging, digital arts are positioned to take a lead in infusing life with creativity, innovation, and new art forms, as life plays out in extended reality merging real and virtual. With advances in artificial intelligence and global connectivity, digital human behavior between reality and virtuality, the pace of computational transformation is accelerating, putting into question basic assumptions about life and art beyond human experience. Work by Baidu, a major Chinese AI and tech firm, notes that 'Digital humans powered by artificial intelligence are learning increasingly human-like behavior to become an essential part of our lives'.

We delve into human computational behavior, a key driver to the reception, development, and use of technology, ranging from smartphones to computer devices embedded in our personal and shared environments. Seeing that on average people use their smartphones some ten hours per day, but in practice, they are connected via multiple devices 24/7, places the human computational relationship at the heart of computational culture, which accelerates its use and adoption inspiring a truly revolutionary shift in the landscape of life, art, science, and technology.

This book explores human existence in the space between life as we knew it and life having evolved over the more than two years of COVID-19. The state of human experience to which we return is one of the dynamic changes impacting how we see ourselves and the arts. What choices will we have to chart our future, real and virtual? The world, like a global stage where daily conversations among billions of participants chart new directions during turbulent times, sits in sharp contrast to the deserted public square during the COVID-19 lockdown. Now, two years later, we are faced with the death and destruction of two ongoing wars, in Ukraine and Israel causing chaos and collateral damage on many fronts from city streets and universities to state and federal centers of power. Yet in parallel to this volatile environment, the arts and computational culture are in the middle of revolutionary change, transforming the arts in 'the age of AI'. Given its pace of acceleration impacting ways of living, working, and loving, we endeavor to present the arts in the past, present, and future, from both historical and current perspectives of these challenging times, considering various aspects in the chapters within this book.

In this book, we present global interdisciplinary research bringing new perspectives on how the rapid shift from digital culture to computational culture is being shaped by the infusion of new computational innovation creating new tools and technologies for arts tied to computing, human communication, experience, interaction, and expression across new media. As we move from a text-based to a visual and audio world of learning and knowing, one increasingly led by our human senses of seeing, hearing, feeling, and touching, to emotions and states of mind and being, we

become acutely aware of the radical changes occurring to our sociocultural framework. Not since the French Revolution has change been so swift and oppositional and yet all-inclusive in its impact on the arts and sciences as life evolves through a computational reordering of doing, knowing, and being.

The book's 27 richly illustrated chapters by distinguished international authors from different backgrounds in the arts and computing share their journey in computational time and space. Beginning with the Renaissance, progressing to the present and into the future, the book traces the steps of computational and cultural transformation, focusing on some key influencers in arts, science, and technology. This includes musicians, performing artists, and poets, who wrought critical changes to minds and hearts, while positioning the arts as the driving force for new ways of thinking about life on planet Earth. Many of these artists sought freedom, refuge, and peace post-World War I and World War II and became immigrants to the USA, contributing significantly to the brilliance of American science and culture.

The book is organized into seven parts, each with several chapters.

**Part I: Prelude to 21st Century Computational Culture: Pioneers of Art and Science** presents Chaps. 1–4:

Chapter 1 “Leonardo da Vinci, Renaissance Icon of Art and Science: Being Human and Beyond” shows how Leonardo da Vinci’s ways of being an artist, thinking, and seeing life and nature achieved a seamless integration of art and science. This involved a new conceptual model that absorbed his passion and love defining what it means to be human, that now underpins and inspires the AI revolution. Chapter 2 “Évariste Galois and His Circle: Mathematics, Romanticism, and Revolution” covers the French mathematics genius, Galois (1811–1832), who although died at young age of 20, brought art, new esthetics, and elegance to algebra and group theory, asserting the spirit of freedom of expression and individuality. Chapter 3 “Alan Turing: Breaking the Code, Computing, and Human Identity” delves into the life and work of Alan Turing (1912–1954), father of computer science and machine intelligence and pioneer for gay rights, so that his work is seen as foundational and inspirational to the age of artificial intelligence (AI) and machine learning (ML). Chapter 4 “The Digital Road to the Age of AI” journeys from the 1960s to the present, as it highlights computer visionaries in the likes of Vint Cerf, co-inventor of the internet in 1973, and Tim Berners-Lee, inventor of the World Wide Web in 1989, and delves into the revolutionary artists who introduced and inspired modernism, from Picasso, Miro, Chagall, and Andy Warhol to the present with computer artists such as Refik Anadol.

**Part II: Curating Art: A Paradigm Shift from Digital to Computational Culture** includes Chaps. 5–8:

Chapter 5 “Transformations: Media Arts for Representation and Change” features interviews with leading educators in computing arts, exhibitions, and learning. Chapter 6 “Conservation of Digital Arts Heritage: The Computer Arts Archive” celebrates its founding in 2020, reaching back to the founding in 1968 of Computer Arts

Society (CAS), as they collaborate on collecting, organizing, and exhibiting materials from 1968 to present and into the future and draw inspiration from computer art history revealed in their collections, as they converge with a new flourishing of computational arts. Chapter 7 “Case Studies in Digital Heritage Preservation: Seeing Through the Lens of Computational Culture” is presented at a critical juncture where new image technologies are widely available, easy to use, and affordable which is demonstrated by several case studies designed to be eye-opening to creators of image-based artwork at a time when visual interaction is at the center of our lived experience. Chapter 8 “Digital Preservation and Access: Photography Past, Present, and Future” offers sophisticated hybrid approaches to photographic documentation processes that support narratives past to present across image technology boundaries presented by photography expert and artist, Graham Diprose who takes the reader on an exciting journey through case studies.

**Part III: Art and Emerging Sociocultural Global Movements** presents Chaps. 9–11:

Chapter 9 “Vision and Virtuality: Future Images, Contemplation, and Computational Culture” centers around philosophical ideas of likenesses and how they inform debates about the meaning and the relation to images in the digital age as we increasingly see the world as an image, part of many longstanding metaphysical ideas about meaning and reality, and how these ideas might inform contemporary discussions about computational culture and virtuality. Chapter 10 is titled “The Promise of Pastiche: How AI Systems Pervade the Cultural Heritage Sector”. The human–machine interaction of large-scale learning models (LLMs) and artificial intelligence (AI) art generators set up enormous copyright challenges for the cultural heritage sector when the provenance of an image may be a pastiche of all sorts of images scraped off the internet, but the only information inscribed in their metadata relates to the prompt and the model that created it. At the heart of the matter is that generative art is replacing the use of images from stock photographs or artist portfolios. Chapter 11 “Visualizing and Unveiling Our Information Landscape” delves into society’s increasingly complex information landscape, exploring the emerging virtual-physical worlds that now underpin much of everyday life, shedding light on unseeable frameworks and shifting structures, critiquing the ‘black boxes’ that surround our digital lives and data, constructing artworks and experiences that visualize and unveil important contexts and ‘truths’ of this technological age engendering both intellectual and emotional responses.

**Part IV: The Metaverse** includes Chaps. 12–16:

Chapter 12 “The Metaverse and Expo 2020: VR, AR, MR, and XR” considers developments in the virtual Metaverse, using the Expo 2020 international showcase as a case study. Chapter 13 “Hyperhumanism Versus Transhumanism in New Media Art” navigates the accelerating landscape of technology and artificial intelligence (AI) as New Media Art is positioned as an imperative nexus, dissecting the intricate dance of human inventiveness, where radical philosophies explore the theoretical

backbone of these philosophies and influence on natural intelligence (NI) revealing resonances in the realm of New Media Art. Chapter 14 “Performance and Virtual Reality: The Stage as a Multidimensional Environment” is set to change radically with the increasing inclusion of virtual reality (VR) technologies into creative practice exploring foundational works as well as a new breed of artists using VR to present multi-modal ways in which artists in VR performance experiment while presenting notable artists, their works, and emerging voices in this area. Chapter 15 “Lacan and Žižek in the Metaverse” considers the Metaverse through the lens of Sigmund Freud and the philosopher and cultural theorist, Slavoj Žižek, and especially French psychoanalyst and psychiatrist, Jacques Lacan, whose psychoanalytical thought offers a powerful means of understanding the underlying desires driving the development of new technologies and allows us to see how the Metaverse manifests elements of our unconscious response to our own humanness. Chapter 16 “Augmented Reality in Digital Art: Case Histories and Future Directions” explores the intersection of augmented reality (AR) and digital art, highlighting the potential of AR to transform the way we create, experience, and interact with art, and presents a short history of AR projects discussing the challenges and perspectives on the future of AR in digital art.

**Part V: Education in the Age of Computational Culture** presents Chaps. 17–19:

Chapter 17 “Computer Arts Education: Creative Process and AI Challenges” teaches computer arts to aspiring graduate students, developing their knowledge and skills for successful careers across new media, film, and video set in a computational world using creative approaches featuring teamwork, high-tech laboratories, shared experiences, and digital curation in the spirit of innovative thinking and imagination, a conversation between Tula Giannini and Terrance Masson. Chapter 18 “The Arts and Integrative Medicine: A Doctor’s Journey to Healing Mind, Body, and Soul” explores the arts and integrative medicine considering emerging developments inspiring holistic approaches to human health and healing illuminated through a conversation focusing on Dr. Victoria’s personal medical journey as a practicing doctor from her medical education to medical practice east and west including meditation, psychology, yoga, and Ayurveda practice. Chapter 19 “Immersive Serious Games: Shifting Paradigms from Activism to AI” focuses on the transformational development and application of immersive serious games in the cultural and educational sectors using virtual and augmented reality and computational and machine learning technologies, such as generative art, changing the ways in which interactive learning and storytelling are being experienced.

**Part VI: Human States of Being: Real and Artificial Consciousness** includes Chaps. 20–24:

Chapter 20 “Arts in the Public Square: Reality and VirtualSpace” looks at changes wrought by the pandemic when humans were experiencing life mostly from home while the public square, museums, theaters, and university campuses were closed as we experienced radical social and cultural change shifting to virtual life, social

media, online communications, and smartphones, only gradually returning to the public square, but owing to the AI the revolution, life, as it was before, was not to return. Chapter 21 “The Senses Beyond: New Directions in Game Engine Experiences” elucidates video games as a significant part of the audiovisual culture while game engines are widely used not only for the construction of video games, but also arts projects, virtual reality experiences, and serious or educational games of student projects for the digital media BSc degree programs at the University of Greenwich. Chapter 22 “Insights into Digital Experience Practices: Extending Senses in Arts and Performance” follows the journey of a performance and digital media artist’s practices delving into curatorial research revealing various approaches to interactive arts and performance that extend the human body with wearable devices and other technologies expanding the senses, blurring physical and virtual. Chapter 23 “Cultural Conflict and Heritage: Global Human Interaction”, seen in the rise of political strife across the globe when arts institutions are rethinking collection interpretations and exhibition narratives, reflects on the sociocultural environment outside the museum walls, both real and virtual. Chapter 24 “Arts Research in a Computational Framework” explores how computational culture is transforming arts research in the context of human digital behavior and experience combined with the rapid evolution of global communication and interaction in physical and virtual environments.

**Part VII: The Future of Computational Arts and Life** presents Chaps. 25–27:

Chapter 25 “Connecting in Global Multi-modal Environments: Post-normative (Im)materiality and Equity” focuses on how new perspectives on heritage, human esthetics, and cultural conflict are shaping arts communities and extending our path of discovery and shines a light on the need for broad participation of diverse cultures in shaping the future of cultural organizations and social life around the arts. Chapter 26 “Computer Arts Society: Charting Present to Future” brings historical perspectives to computer arts to gain new insights into its future. Chapter 27 “The Future of the Arts in a Computational Culture” evaluates possible future trends in computational culture drawing on the contents of the book’s chapters while focusing on new developments as we enter the ‘Age of AI’ in ways that challenge human intelligence, spark human-AI partnerships rife with human displacement, societal disruption, and chaos. We are challenged to seek new ways of being more than human while cherishing our hard-won freedoms and individual identity as we continue to advance the arts across an expanding global stage where reality and virtuality morph.

This book on *The Arts and Computational Culture* brings together the multifaceted aspects of human development as we enter the age of AI. We juxtapose a broad spectrum of interdisciplinary influences on the arts defined broadly as we seek to gain a deeper understanding of being human in a world increasingly challenged by virtual life and the Metaverse. From avatars and robots to embedded technology, we are experiencing a redefinition of consciousness and states of mind and body. In this new landscape that we all inhabit, artists of all types are at the forefront of bringing new vision, creativity, and imagination, to ways of seeing and doing as they work at that critical intersection between real and virtual lives.

We are also experiencing a new sociocultural world order, powered by an emerging computational global framework. Led by the arts, computing, and technology and personified by 21st-century visions of human identity and consciousness, computational culture captures the hearts and minds of millions of people participating in a virtual public square 24/7. As our global conversation and interaction, where east meets west shapes Earth's evolving cultural ecosystem, we are transforming the arts imbued with a new vision of science and technology tied to emerging computational human experience, values, and ethics. This book aims to provide a selection of views on the issues involved in this transformation.

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2024

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Jonathan P. Bowen



# Acknowledgements

The annual EVA London Conference on *Electronic Visualisation and the Arts* has been influential on the contents and selection of authors in this volume. Some of the materials in chapters by the editors have been adapted and updated from recent papers in this conference. Thank you to all artists and photographers who have allowed their work to appear in this book, especially Paul Brown for the frontispiece. These are acknowledged individually in figure captions in the book. Organizations that have allowed illustrations to be included are also acknowledged in the relevant figure captions within the book, and we thank these institutions for their generosity. Some photographs and images are from Wikimedia Commons (<http://commons.wikimedia.org>), and we thank the contributors to this wonderful altruistic online facility. Again, such images are individually acknowledged in figure captions where appropriate. The following chapter authors reviewed other chapters in the book: Camille Baker, Stefania Boiano, Ann Borda, Jonathan Bowen, Moshe Caine, Graham Diprose, Giuliano Gaia, Charlie Gere, Tula Giannini, Oliver Gingrich, Susan Hazan, Nick Lambert, Gareth Polmeer, Carl Smith, Natasha Trotman, and Jonathan Weinel. All chapters were reviewed by at least three reviewers. We are especially grateful to Graham Diprose for additional support in producing this book. Robin Darwall-Smith, Jeff Robins, and Mike Seaborne provided help reading and checking parts of the book. Finally, Jonathan Bowen thanks Museophile Limited for financial support.

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# Editors and Contributors

## About the Editors

**Tula Giannini** is former Dean and Professor in the School of Information at the Pratt Institute, New York, USA. She was formerly Dean of the School during 2014–2017. At Pratt, she has initiated and managed several successful collaborative digitization projects with leading New York City museums, libraries, and related cultural institutions, supported by the Institute of Museum and Library Services (IMLS) and other funding agencies. She has also established a Master of Science (MS) in *Museums and Digital Culture*. She has co-organized the EVA London Symposium, associated with the annual EVA London Conference on *Electronic Visualisation and the Arts* since 2016. She co-edited the 2019 book *Museums and Digital Culture* in the Springer Series on Cultural Computing. Professor Giannini has an interest in musicology and has contributed entries in *The Grove Dictionary of Musical Instruments*, published by Oxford University Press.

**Jonathan P. Bowen, FBCS FRSA** is Emeritus Professor of Computing at London South Bank University in London, UK, and Chair of Museophile Limited, a UK consultancy company in the field of museums and IT. In 1994, he founded the *Virtual Library museums pages* (VLmp), part of the WWW Virtual Library, later adopted by the International Council of Museums (ICOM). He was invited to be Honorary Chair of the first *Museums and the Web* conference in 1997 and was Regular Contributor subsequently. More recently he has been Co-chair of the annual EVA London Conference on *Electronic Visualisation and the Arts*. In 2013, he was Co-editor of *Electronic Visualisation in Arts and Culture*, published in the Springer Series on Cultural Computing. In 2017, he co-authored *The Turing Guide*, on the life and work of the computing pioneer Alan Turing, published by Oxford University Press, and in 2019, he co-edited *Museums and Digital Culture*, again in the Springer Series on Cultural Computing. Professor Bowen is Life Fellow of the British Computer Society (BCS), Life Fellow of the Royal Society of Arts (RSA), and Emeritus Freeman of the Worshipful Company of Information Technologists (WCIT).

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# Abbreviations

"	Inches
24/7	24 hours a day, 7 days a week
2D	Two-dimensional
3D	Three-dimensional
AAAI	Association for the Advancement of Artificial Intelligence
ACE	Automatic Computing Engine
ACM	Association for Computing Machinery
ADC	Accessibility Discovery Centre
ADiE	Artistic Doctorates in Europe
AG	Aktiengesellschaft
AGI	Artificial General Intelligence
AGM	Annual General Meeting
AHRC	Arts and Humanities Research Council
AI	Artificial Intelligence
AIS	Association for Information Systems
AISB	Society for the Study of Artificial Intelligence and Simulation of Behaviour
A-Life	Artificial Life
ALS	Autograph Letter Signed
AMNH	American Museum of Natural History
AP	Associated Press
API	Application Program Interface
AR	Augmented Reality
ASC	Altered State of Consciousness
ASCII	American Standard Code for Information Interchange
AT&T	American Telephone and Telegraph
ATech	Assistive Technology
AV	Audiovisual
b.	Born
BA	Bachelor of Arts
BAME	Black, Asian, and Minority Ethnic

BBC	British Broadcasting Corporation
BCE	Before Common Era
BCS	British Computer Society
BDSM	Bondage, Discipline/Domination, Sadism/Submission, Masochism
BFA	Bachelor of Fine Arts
BFI	British Film Institute
BIE	Bureau International des Expositions
BioArt	Biological Art
BME	Black and Minority Ethnic
BNF	Bibliothèque Nationale de France
BP	British Petroleum
BPA	Bisphenol A
BPL	Brooklyn Public Library
BSI	British Standards Institution
CA	California
CACHE	Computer Arts Contexts Histories etc.
CAD	Computer-Aided Design
CAS	Computer Arts Society
CAT	Computer Art and Technocultures
CBS	Columbia Broadcasting System
CE	Common Era
CE	Context Engineering
CEO	Chief Executive Officer
CERN	Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
ChatGPT	Chat Generative Pre-trained Transformer
CIA	Central Intelligence Agency
CIC	Community Interest Company
CIS	Commonwealth of Independent States
CLIP	Contrastive Language-Image Pre-training
CNBC	Consumer News and Business Channel
COVID	Coronavirus Disease
CRT	Cathode Ray Tube
CTO	Chief Technology Officer
d.	Died
D.C.	District of Columbia
DC	Double Consciousness
DDC	Dewey Decimal Classification
DiGRA	Digital Games Research Association
DIY	Do-It-Yourself
DJ	Disc Jockey
DM	Direct Message
D-max	Maximum optical Density
DNA	Deoxyribonucleic Acid
DNG	Digital Negative



DNS	Domain Name System
dpi	Dots Per Inch
DSLR	Digital Single Lens Reflex
E.A.T.	Experiments in Art and Technology
EC	European Commission
ed	Editor
eds	Editors
EEG	Electroencephalogram
EMF	Electromagnetic Field
EMS	Electronic Music Studios
ESPRIT	European Strategic Program on Research in Information Technology
EU	European Union
EVA	Electronic Visualisation and the Arts
eWiC	Electronic Workshops in Computing
Expo	Exposition
EYSIC	Election Year Strategy Information Center
Fab lab	Fabrication laboratory
FBI	Federal Bureau of Investigation
FDA	Food and Drugs Administration
FET	Future and Emerging Technologies
FLI	Future of Life Institute
Flux	Art in Flux
FOIA	Freedom of Information Act
FOV	Field Of View
FP	Framework Programme
FP7	Seventh Framework Programme
FTP	File Transfer Protocol
GAI	Generative Artificial Intelligence
GAN	Generative Adversarial Network
GAPPP	Gamified Audiovisual Performance and Performance Practice
GenAI	Generative Artificial Intelligence
GIF	Graphics Interchange Format
GLAM	Galleries, Libraries, Archives, and Museums
GMO	Genetically Modified Organism
GOAP	Goal Oriented Action Planning
GP	General Practitioner
GPT	Generative Pre-trained Transformer
gsm	Grams per Square Meter
GUESS	Game User Experience Satisfaction Scale
HAL	Human Artificial Life
HCI	Human-Computer Interface
HE	Higher Education
HHI	Human-Human Interface
HHS	Health and Human Services

HITL	Human-In-The-Loop
HMI	Human-Machine Interface
HP	Hewlett-Packard
HPA	Human Protein Atlas
HQ	Headquarters
HTB	Hacking the Body
HTC	High Tech Computer
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
IBM	International Business Machines Corporation
ICA	Institute of Contemporary Arts
ICANN	Internet Corporation for Assigned Names and Numbers
ICIJ	International Consortium of Investigative Journalists
ICOM	International Council of Museums
ICT	Information and Communications Technology
IDRP	Inclusive Design Review Panel
IEEE	Institute of Electrical and Electronics Engineers
IFIP	International Federation for Information Processing
IMLS	Institute of Museum and Library Services
INS	Immigration and Naturalization Service
iOS	iPhone Operating System
IoT	Internet of Things
IRL	In Real Life
IRS	Inland Revenue Service
IRT	In Real Time
ISA	International Space Agency
ISBN	International Standard Book Number
ISDN	Integrated Services Digital Network
ISEA	International Symposium on Electronic Art
IT	Information Technology
JPEG	Joint Photographic Experts Group
JPG	Joint Photographic experts Group
KCL	King's College London
LA	Los Angeles
LA Phil	Los Angeles Philharmonic Orchestra
LaMDA	Language Model for Dialogue Applications
LAN	Local Area Network
LCC	London College of Communication
LED	Light-Emitting Diode
Leonardo	Leonardo da Vinci
LFRP	London's Found Riverscape Partnership
LGBTQ	Lesbian, Gay, Bisexual, Transgender, Queer or Questioning
LGBTQIA	LGBTQ, Intersex, and Asexual
LIDAR	Laser Imaging, Detection, And Ranging
LiDAR	Light Detection And Ranging

LLM	Large Language Model
LMIC	Low- and Middle-income Countries
LOL	Laugh Out Loud
LSD	Lysergic Acid Diethylamide
LZW	Lempel–Ziv–Welch (data compression)
M3GAN	Model 3 Generative Android
MA	Master of Arts
Mac	Apple Macintosh
MAP	Museum of Art Pudong
MBRL	Mohammed Bin Rashid Library
MC	Minutier Central des Notaires
MD	Doctor of Medicine
MECC	Minnesota Educational Computing Consortium
Met	Metropolitan Museum of Art
MFA	Master of Fine Arts
MFACA	Master of Fine Arts Computer Arts
MGP	Mathematics Genealogy Project
MIT	Massachusetts Institute of Technology
ML	Machine Learning
MoMA	Museum of Modern Art
MP	Member of Parliament
MR	Mixed Reality
MS	Master of Science
MTV	Music Television
MxR	Mixed Reality
NAA	National Archives of Australia
NASA	National Aeronautics and Space Administration
NBC	National Broadcasting Company
ND	Neurodivergent
nd	No Date
NFT	Non-Fungible Token
NGO	Non-Governmental Organization
NI	Natural Intelligence
NJ	New Jersey
NLP	Natural Language Processing/Programming
NMS	National Museum of Scotland
NMWA	National Museum of Women in the Arts
NPC	Non-Player Character
NPL	National Physical Laboratory
NSTC	National Science and Technology Council
NT	Neurotypical
NY Times	The New York Times
NY	New York
NYC	New York City
NYIT	New York Institute of Technology

OCR	Optical Character Recognition
ODI	Open Data Institute
OLM	Oriental Light and Magic (company)
OpenAI	Open Artificial Intelligence
OS	Operating System
OSTP	Office of Science and Technology Policy
OUP	Oxford University Press
p	Page
PAA	Park Avenue Armory
PAC	Perelman Performing Arts Center
PaLM	Pathways Language Model
PBS	Public Broadcasting Service
PC	Personal Computer
PDF	Portable Document Format
PhD	Doctor of Philosophy
PNG	Portable Network Graphics
POV	Point Of View
pp	Pages
PS	PlayStation
q.v.	Quod vide (which see)
QAA	Quality Assurance Agency for Higher Education
R&B	Rhythm and Blues
R&D	Research and Development
RA	Royal Academy
RCA	Royal College of Art
REF	Research Excellence Framework
RFID	Radio Frequency Identification
RGB	Red, Green, Blue
RSA	Royal Society of Arts
RTI	Reflectance Transformation Imaging
SAM	Sound Activated Mobile
SEC	Securities and Exchange Commission
SFMOMA	San Francisco Museum of Modern Art
SG	Specialist Group
SIG	Special Interest Group
SIGGRAPH	Special Interest Group on Computer Graphics
SLR	Single Lens Reflex
SME	Small and Medium-sized Enterprises
SOAE	Stanford Ocean Acidification Experience
SSCC	Springer Series on Cultural Computing
SSD	Solid State Drive
STEAM	Science, Technology, Engineering, Arts, and Medicine
STEM	Science, Technology, Engineering, and Medicine
SVA	School of Visual Arts
SWPA	Sony World Photography Awards

TCP/IP	Transmission Control Protocol/Internet Protocol
ThIATRO	The Immersive Art Training Online
TIFF	Tag Image File Format
ToDA	Theatre of Digital Art
TV	Television
UAE	United Arab Emirates
UCCA	Ullens Center for Contemporary Art
UCL	University College London
UI	User Interface
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children's Emergency Fund
UPI	United Press International
URL	Uniform Resource Locator
USA	United States of America
UTA	United Talent Agency
UV-VIS-IR	Ultraviolet, Visible, Infrared
UX	User Experience
V&A	Victoria and Albert Museum
VJ	Video Jockey
VLmp	Virtual Library museums pages
VR	Virtual Reality
VRML	Virtual Reality Modeling Language
W3C	World Wide Web Consortium
WCIT	Worshipful Company of Information Technologists
WDCH	Walt Disney Concert Hall
Web	World Wide Web
Web3	Web 3.0
WGA	Writers Guild of America
WHO	World Health Organization
Wi-Fi	Wireless Fidelity
WIR	Wilhelm Imaging Research
WWI	World War I
WWII	World War II
WWW	World Wide Web
X	Twitter
XAI	Explainable AI
XML	Extensible Markup Language
XR	Extended Reality
ZKM	Zentrum für Kunst und Medien

**Part I**  
**Prelude to 21st Century Computational  
Culture: Pioneers of Art and Science**