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Preface

Welcome to the 27th annual Bridges Conference! Here at Virginia Commonwealth University, we have been working toward this event since before COVID-19, as we were originally scheduled to host in 2022. We are exceedingly happy to finally have you here with us to celebrate Mathematics and the Arts in one of the most artistically, historically, culturally, educationally, recreationally, and culinarily vibrant cities in the U.S.

Richmond, the capital of Virginia, sits along the beautiful James River and offers a wide range of cultural, dining, and outdoor experiences. With museums like the Virginia Museum of Fine Art, murals decorating the cityscape, and performance venues like the Carpenter Theater, it is no wonder that Richmond was named the most artistic mid-sized city in America in 2023. It has been named a top food destination by National Geographic, and the world-class Richmond Beer Trail makes the city also a top destination for craft brewing. Richmond is the only city in the States where you can paddle Class IV rapids. It hosts a scenic network of hiking and biking trails along the James River and throughout the city, including the 52-mile Virginia Capital bicycle trail from Richmond to Williamsburg.

Richmond is one of the oldest cities in the country. Patrick Henry famously said, “Give me liberty or give me death” at St. John’s Church in the months leading up to the American Revolutionary War. During America’s Civil War, Richmond served as the capital of the Confederate States. More recently, the statue of Confederate General Robert E. Lee on Monument Avenue became a focal point of protests during the Black Lives Matter movement. This monument, along with all other Confederate statues along this street, have since been removed. There are many opportunities to experience the rich culture and history of Richmond with museums like the American Civil War Museum, Holocaust Museum, the Black History Museum and Cultural Center of Virginia, and the Edgar Allan Poe Museum, as well as the Hollywood Cemetery, where two United States presidents are buried.

VCU’s urban campus is home to a vibrant academic community situated in the heart of Richmond. With a current enrollment of over 28,000 students, VCU is known for its commitment to innovation, diversity, and excellence in education, research, and healthcare. The Department of Mathematics and Applied Mathematics at VCU is recognized for its cutting-edge research across a wide array of areas such as analysis, knot theory, mathematical biology, mathematical modeling, mathematical physics, mathematics education, logic, geometry, and graph theory. Committed to excellence in teaching, the department offers a comprehensive curriculum at both the undergraduate and graduate levels that equips students with the analytical skills and theoretical knowledge necessary for success in academia, industry, and beyond. The VCU School of the Arts (VCUarts), consistently ranked among the top art schools in the nation, offers an extensive array of undergraduate and graduate programs spanning disciplines such as fine arts, design, fashion, and performing arts. Currently, the VCUarts graduate program (MFA) is ranked #4 in the country by U.S. News & World Report. With state-of-the-art facilities and a

faculty of accomplished artists and designers, VCUarts provides students with unparalleled opportunities for exploration and expression in the arts.

We are thankful for support received from VCU and VCU's College of Humanities and Sciences for the use of the brand-new STEM building. Thanks to the Science Museum of Virginia for hosting Family Day as well as a small yearlong exhibition of art pieces owned by the Bridges Organization. We would like to thank the local organizing committee consisting of Brent Cody, Punit Gandhi, Richard Hammack, Glenn Hurlbert (co-chair), Oleksandr Misiats, and Ihsan Topaloglu (co-chair). A special thanks is due to Ellie Roberts for her tireless organizational efforts and her fortitude in dealing with many technical administrative issues; her industriousness made this conference possible. Let us thank Lindsey West for producing the conference video and Jocelyn Rodriguez for designing the conference poster. We would like to acknowledge Lynn Foshee Reed of Maggie L. Walker Governor's School for her help with promoting the conference.

This year's papers were expertly edited by Helena Verrill, who chaired the regular papers program, Karl Kattchee, who chaired the short papers program, S. Louise Gould, who chaired the workshop papers program, and Eve Torrence, who served as managing editor. They were supported by an international Program Committee of over 80 experts, who provided extensive peer reviews and editorial comments on submissions. Special thanks to Math + Fashion co-chairs Uyen Nguyen and Susan Goldstine, Poetry Reading chair Sarah Glaz, Short Film Festival chair Susan Gerofsky, Theater Event chair Steve Abbott, and Family Day co-chairs Carolyn Yackel and Eve Torrence. Thank you to David Reimann for designing the covers for the Proceedings and the Art Exhibition catalog and many thanks to Craig S. Kaplan for production of this Proceedings and the Bridges Archive.

The 2024 Bridges proceedings includes 8 invited papers, 40 regular papers, 48 short papers, and 13 workshop papers. These papers cover a wide range of topics, including perspective, fractals, tiling, hyperbolic space, hypercubes, polyhedra, gyroids, puzzles, games, and space filling curves. Music, dance, and poetry are well represented as are fiber arts, with papers on weaving, knitting, crochet, sewing, embroidery, quilts, and fashion. Artists write about their work in a variety of media, from paint and metal to Rubik's cubes. Sculpture, origami, and topology get new treatments and there is a variety of papers on the latest discoveries related to aperiodic tiles. An exciting mix of workshops teach us how to fold origami zonohedra, design polyhedral pysanky, crochet a toroid, dye an orbifold, sew a nine-color map, and weave a Klein quartic.

An exhibition of mathematical art has been an annual feature of Bridges since 2001. Bridges has always interpreted mathematical art broadly, to include all artifacts that express mathematical themes visually. This year we modified the title of the exhibit to communicate its contents more clearly: It will now be called the Exhibition of Mathematical Art, Craft, and Design. Artists participate from around the world, representing diverse cultural backgrounds and showcasing a wide variety of media, from painting and digital prints to textiles, paper folding, holograms, and geometric sculpture. Artists drew inspiration from the mathematics of chaos, tiling, non-

orientable surfaces, group theory, and even mathematical typesetting. This year Bruce Torrence and Robert Fathauer served as co-curators of the exhibition. Richard Hammack and Rachel Quinlan served on the jury along with the curators. The art submission website and the online galleries are administered by Nathan Selikoff. Conan Chadbourne prepared the Art Exhibition catalog, and Richard Hammack served as the local coordinator for the exhibition.

We are grateful to the Bridges community for supporting the Reza Sarhangi Travel Scholarship and Memorial Lecture Fund. Thanks to these generous donations, we were able to offer seven travel scholarships and 21 complimentary registrations for students to participate in the conference this year. This is a testament to the enduring spirit of the Bridges founder Reza Sarhangi, whose legacy lives on through the atmosphere of goodwill and cooperation that he instilled in our community as we work together to further the study of mathematics and art.

The record number of paper submissions this year is proof that the creative connections between mathematics and the arts that Bridges promotes is a thriving area of research. It is wonderful to see the Bridges community continue to grow. We are delighted to welcome you to Virginia Commonwealth University during the first week of August to celebrate these connections with world renowned artists, mathematicians, poets, designers, and educators, amidst the culturally and historically vibrant Richmond community!

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