Five Summations
for four pianos and violin

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five summations for pianos and violin (and computer)

This piece can be rearranged for any instrumentation and can last for any duration. However, this particular performance of the piece will be played on four pianos and one violin. The score is as follows:

"*Instrument one:* $\sum_{k}^{\infty} 1/(4^k)$ *(sum: 4/3 when k=0)*

"*Instrument two:* $\sum_{k}^{\infty} 1/((k+1)(k+2))$ *(sum: 1 when k=0)*

"*Instrument one:* $\sum_{k}^{\infty} 1/(k(k+1))$ *(sum: 1/2 when k=2)*

"*Instrument four:* $\sum_{k}^{\infty} 1/(2^k)$ *(sum: 1/2 when k=2)*

"*Instrument five:* $\sum_{k}^{\infty} (2^{k+3})/(3^k)$ *(sum: 32/3 when k=2)*

each instrumentalist chooses a pitch, which is then transformed into a number based on the chart above. The number becomes k for the first term of the geometric series. The partial sum of the series where k is replaced by number chosen by the performer is calculated by subtracting the partial sum of all the terms between the two k's (i.e. the value shown in the sum in the right column and the value chosen by the player) from the sum shown on the right. This partial sum corresponds to the highest pitch of the instrument and is used as the maximum input argument in the Max/MSP "zmap" patch shown in the attached diagrams. The first term is calculated with k equaling the value chosen by the player, and this result is used as the minimum input in the "zmap" patch. The minimum and maximum output arguments are the numbers corresponding on the above charts to the highest and lowest pitches of the instrument. The first term is then added to the second (substituting k+1 for k) and this value is sent through the "zmap" object, which scales the number to an appropriate range for the instrument. This value is played as the corresponding pitch; if it is between two numbers and cannot be rounded without changing the value substantially, the player should play two adjacent pitches. Each term is added to the one before it $(a_k + a_{k+1} + a_{k+2} ... + a_{k+n})$ *and then scaled to pitch, which may continue indefinitely as the series is infinite, although there may come a point when the numbers are too close together to designate differing pitches, in which case the player may end the piece with the top note on their instrument. Each pitch is played for at least 49 seconds, or as long as it takes for the computer operator to find the next pitch. The second performer should enter 7 seconds after the first, and third 7 seconds after the second, and so forth, just as the second performer should end, ideally 7 seconds after the first, etc. However, the players should not use stopwatches, so the counting is approximate and endings may be extremely far apart. The pitches which are not muted will not last for 49 seconds, so the player should let them fade away and then remain silent for the rest of the duration."*

For this performance, the pitches have been chosen and the calculations have been prepared ahead of time. The number of terms of expansion has also been set at 7, with the eighth pitch being the sum of the series. The numbers chosen by the performers were:

piano 1: c4 (79)
piano 2: f#7 (163)
piano 3: a4 (97)
piano 4: d1 (11)
violin 1: b5 (57)

Piano 1 enters and counts each pitch to 49 seconds before changing. Piano 2 enters seven seconds later and does the same. The notes are played with pedal and held down for the full 49 seconds, whether muted or open, even if the sound has died away. Piano 3 follows, then Piano 4. The violinist enters seven seconds after Piano 4 and plays each note for a single bow length. This bow length should last as long as physically possible within the 49 seconds, but once the player runs out of bow, he or she must wait until they have counted to the end of the 49 seconds before beginning the next pitch, alternating upbows and downbows as usual. Each player should try to play at a softer dynamic than the others, while still being loud enough for the pitches to last at least 7 seconds.

o = 49 seconds
♩ = 7 seconds

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piano 1

piano 2

piano 3

piano 4

violin