A JOURNAL OF THE SOCIETY FOR MUSIC THEORY

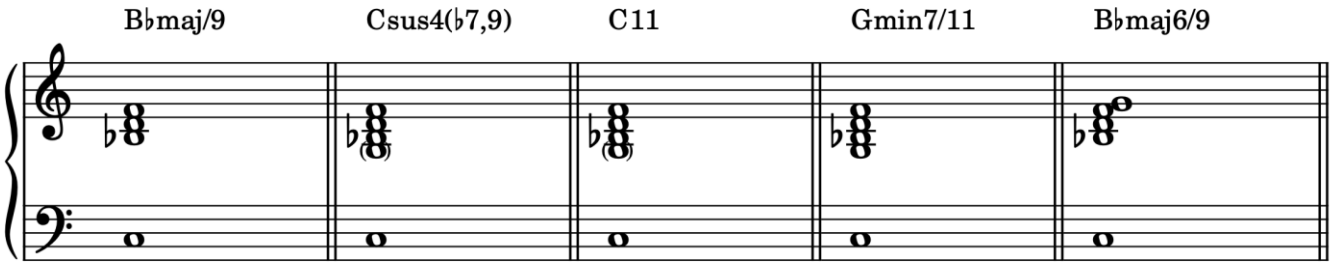
MTO 32.2 Examples: Fink, A Comparison of the Accuracy of Two Models for Predicting the Behavior of "Soul Dominants" in the McGill *Billboard* Corpus

(Note: audio, video, and other interactive examples are only available online)
https://www.mtosmt.org/issues/mto.26.32.2/mto.26.32.2.fink.html

Example 1. Bass-note transitions in the McGill *Billboard* corpus from an eleventh chord (the antecedent, "Ant.") to the ensuing chord (the consequent, "Cons.")

Ant.↓\Cons.→	$\hat{1}$	$\flat\hat{2}$	$\hat{2}$	$\flat\hat{3}$	$\hat{3}$	$\hat{4}$	$\sharp\hat{4}$	$\hat{5}$	$\flat\hat{6}$	$\hat{6}$	$\flat\hat{7}$	$\hat{7}$
$\hat{1}$	454	8	4	4	0	59	0	1	63	4	6	0
$\flat\hat{2}$	0	3	0	0	0	0	0	0	0	0	0	0
$\hat{2}$	3	0	3	0	0	0	0	47	0	0	8	0
$\flat\hat{3}$	0	0	0	2	0	3	0	0	0	0	0	0
$\hat{3}$	0	0	0	1	8	0	0	0	0	0	0	0
$\hat{4}$	32	0	0	24	0	31	0	13	1	3	0	0
$\sharp\hat{4}$	1	0	0	0	8	0	8	0	0	0	0	5
$\hat{5}$	537	17	13	1	44	121	9	158	27	55	9	0
$\flat\hat{6}$	0	4	0	0	0	0	0	0	0	0	2	0
$\hat{6}$	3	0	1	0	10	0	0	3	0	46	0	1
$\flat\hat{7}$	90	0	0	14	0	3	0	24	1	0	14	5
$\hat{7}$	0	0	0	0	0	0	0	0	0	0	1	0

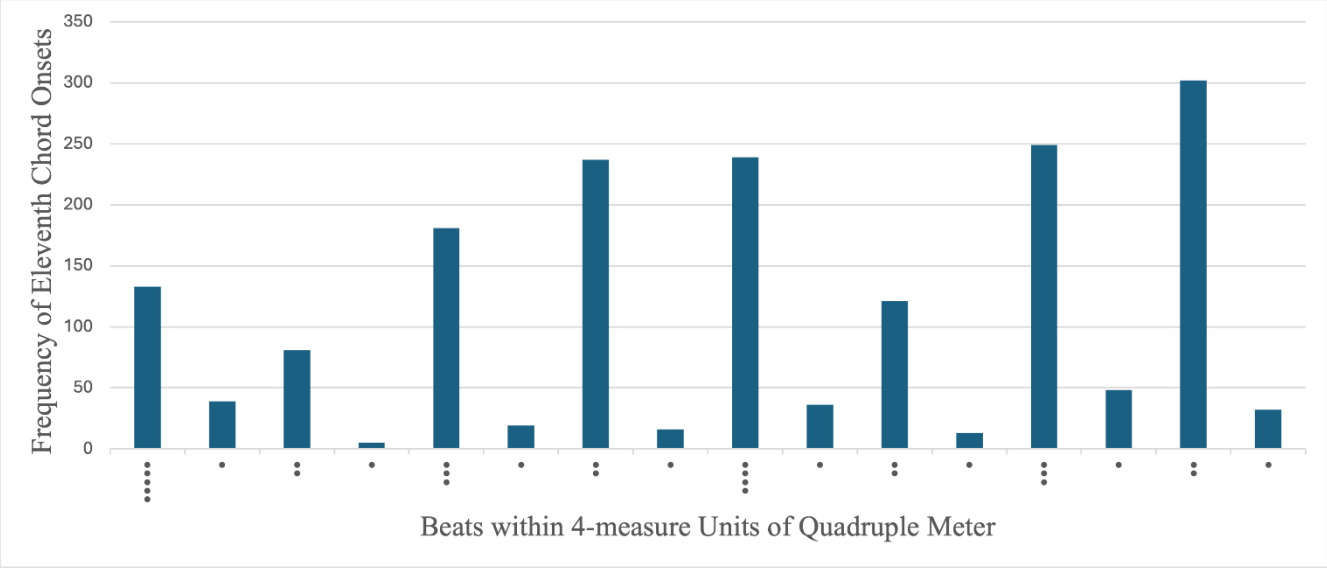
Example 2. Five chord symbols in the MBC transcriptions (Burgoyne 2011)



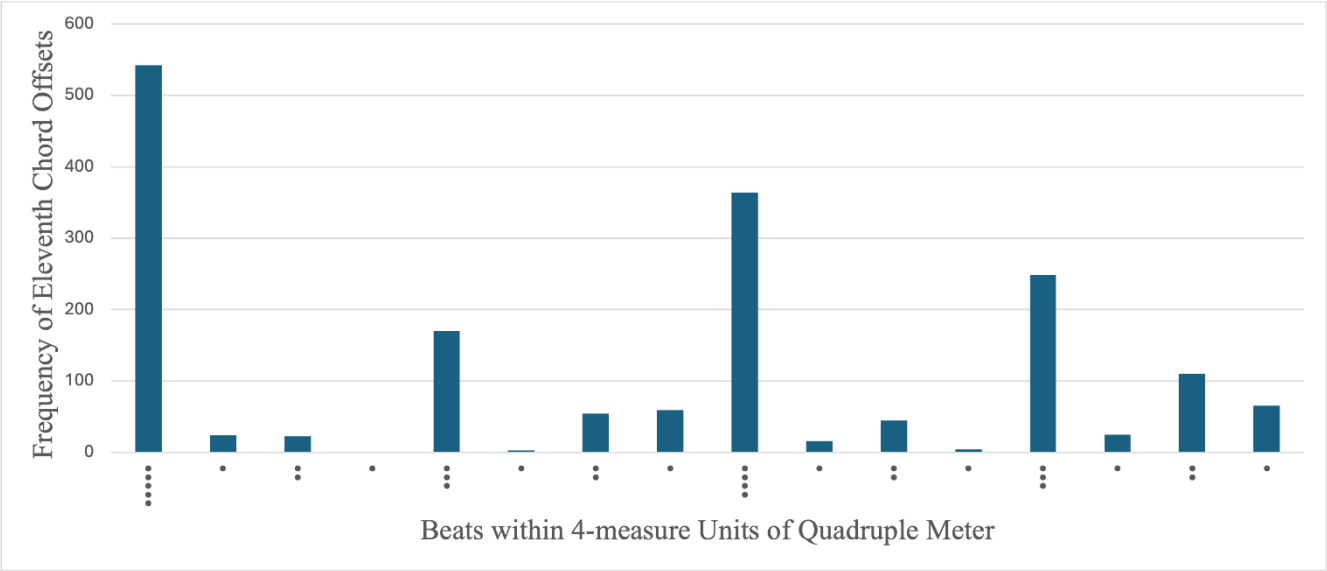
Example 3. Statistics concerning eleventh chords in the MBC

Songs with eleventh chords	153
Percent of songs in corpus with eleventh chords	14.1%
Total number of eleventh chords	2,033
Eleventh chords per song: average	1.54
Eleventh chords per song: standard deviation	6.34

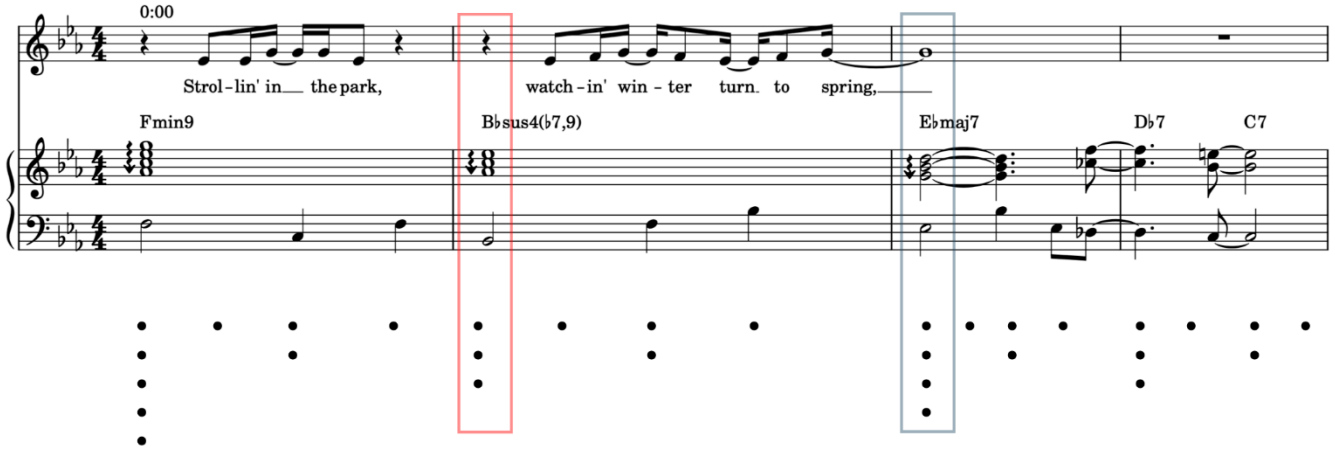
Example 4. Onsets of eleventh chords organized by beats within four-measure units of quadruple meter



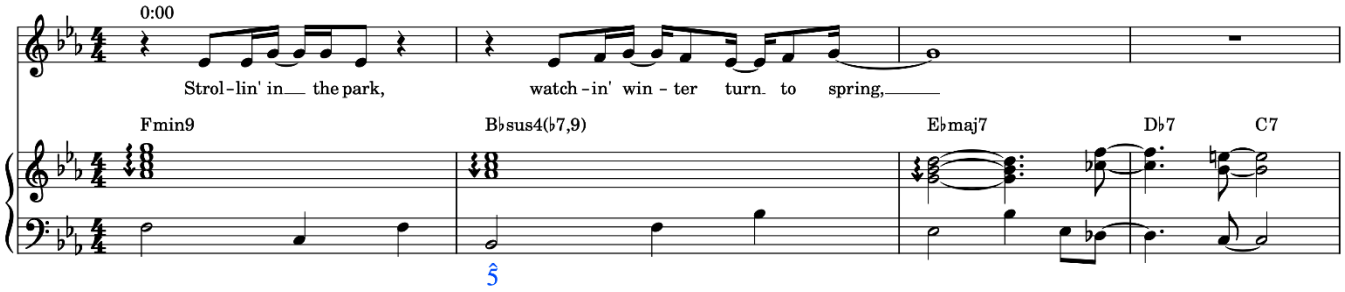
Example 5. Offsets of eleventh chords organized by beats within four-measure units of quadruple meter



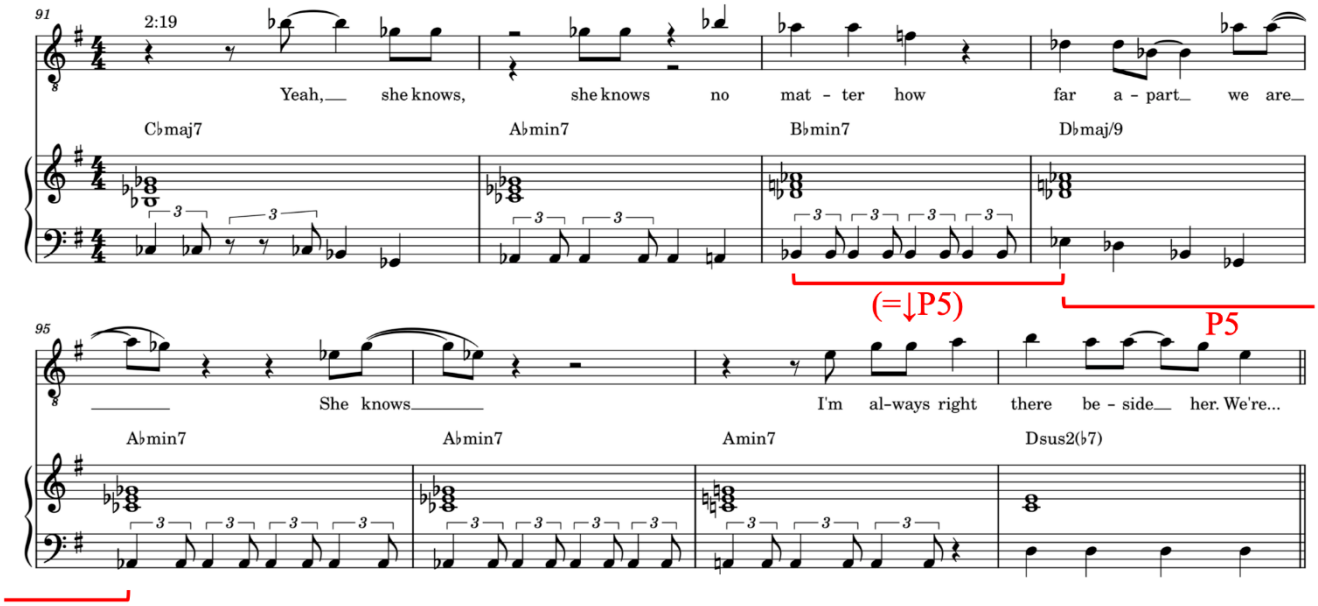
Example 6. The first four measures of Roberta Flack's "Feel Like Makin' Love" (1974). All chord symbols are taken from the MBC transcription. The red box highlights the eleventh chord's onset; the blue box highlights its offset.



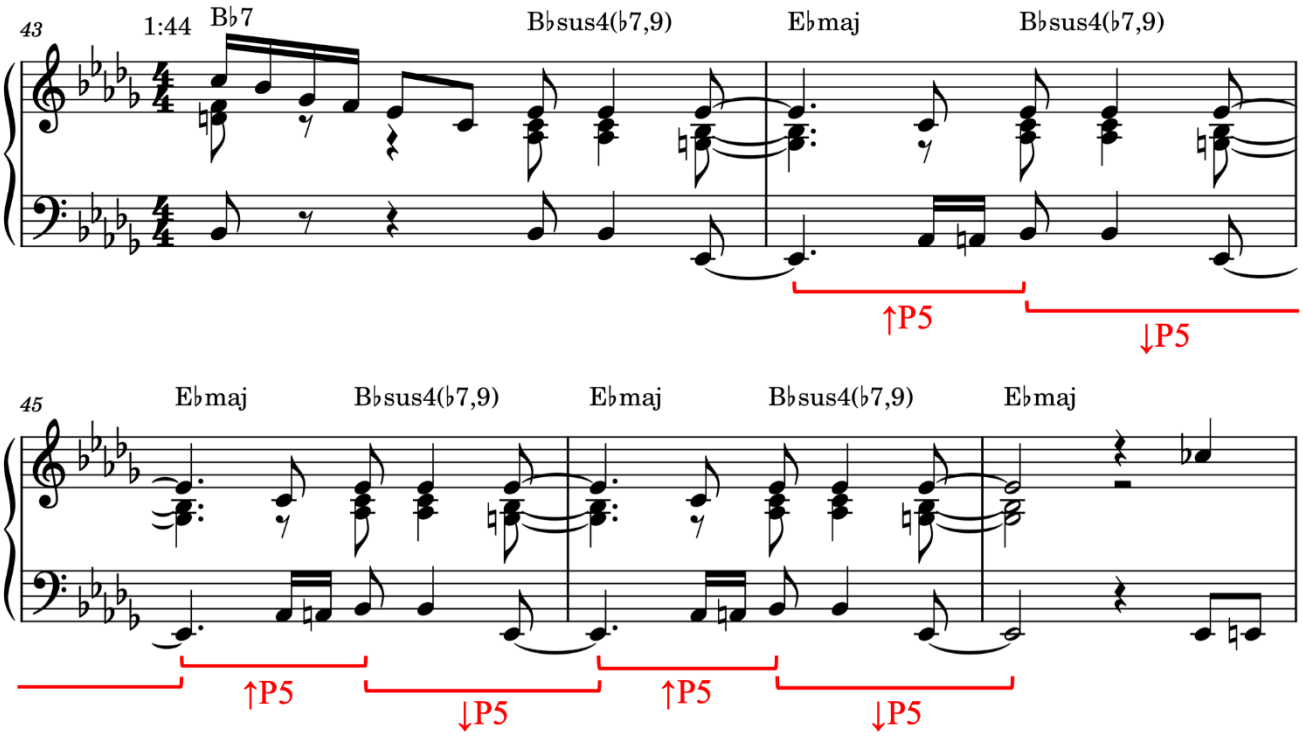
Example 7. The first four measures of Roberta Flack's "Feel Like Makin' Love" (1974). The eleventh chord in m. 2 is built on $\hat{5}$.



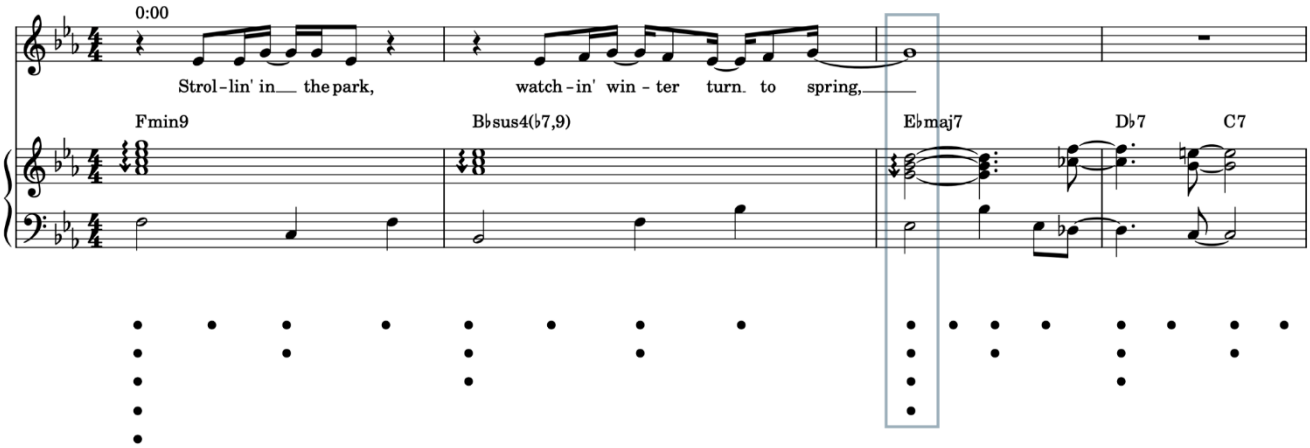
Example 8. The last eight measures of the bridge of Phil Collins's "Two Hearts" (1988). In mm. 93–94, the ascending P4 in the bass is equivalent to a descending P5; in m. 94, D♭maj/9 tonicizes the ensuing chord.



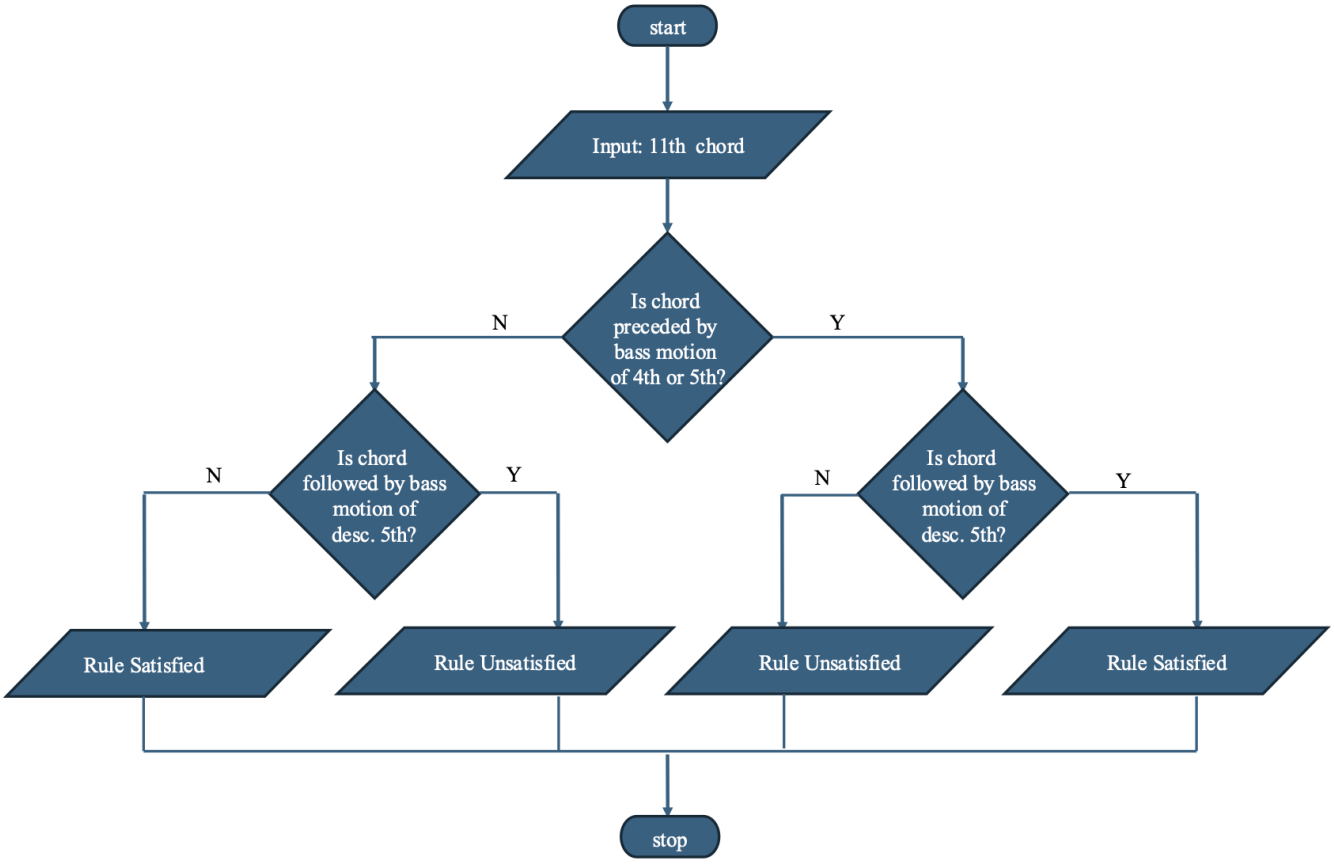
Example 9. Measures 43–47 of Brother Jack McDuff's "Theme from Electric Surfboard" (1969). In mm. 44–46, the B♭sus4(♭7,9) chords tonicize the ensuing chords.



Example 10. The first four measures of Roberta Flack's "Feel Like Makin' Love" (1974). The eleventh chords in m. 2—B♭sus4(♭7,9)—terminates on a strong beat.



Example 11. Flow-chart illustrating the input and output of Model A.



Example 12. Error matrix for a model (Model A) that predicts resolution by descending perfect 5th if and only if an eleventh chord is approached by perfect 4th or perfect 5th.

	Bass NOT Approached by P4 or P5		Bass Approached by P4 or P5		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	1087	930.60	279	435.40	1366
Resolution = ↓P5	298	454.40	369	212.60	667
	1385		648		2033

$$Accuracy = \frac{1087 + 369}{2033} = 72\%$$

$$Sensitivity = \frac{369}{667} = 55\%$$

$$Specificity = \frac{1087}{1366} = 80\%$$

Example 13. Explanation of how to interpret the statistics presented in the error matrix.

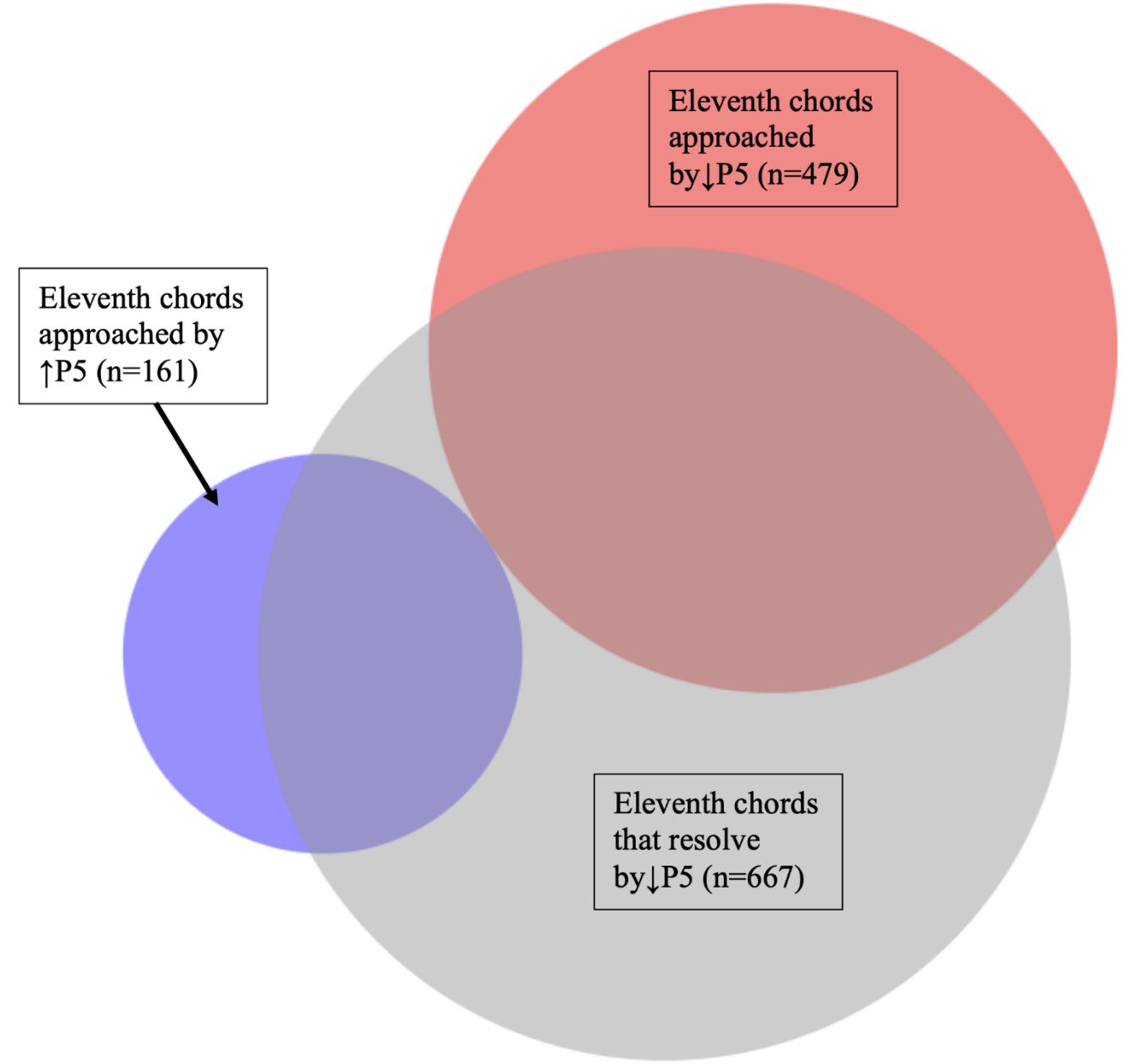
	Predicted Resolution ≠ ↓P5	Predicted Resolution = ↓P5	
Resolution ≠ ↓P5	Rule Satisfied (Resolution ≠ ↓P5)	Rule Unsatisfied (Resolution ≠ ↓P5)	Resolution ≠ ↓P5 Total
Resolution = ↓P5	Rule Unsatisfied (Resolution = ↓P5)	Rule Satisfied (Resolution = ↓P5)	Resolution = ↓P5 Total
	Total Predicted Resolutions NOT by ↓P5	Total Predicted Resolutions by ↓P5	Total

$$Accuracy = \frac{Rule\ Satisfying\ Eleventh\ Chords}{Total\ Eleventh\ Chords}$$

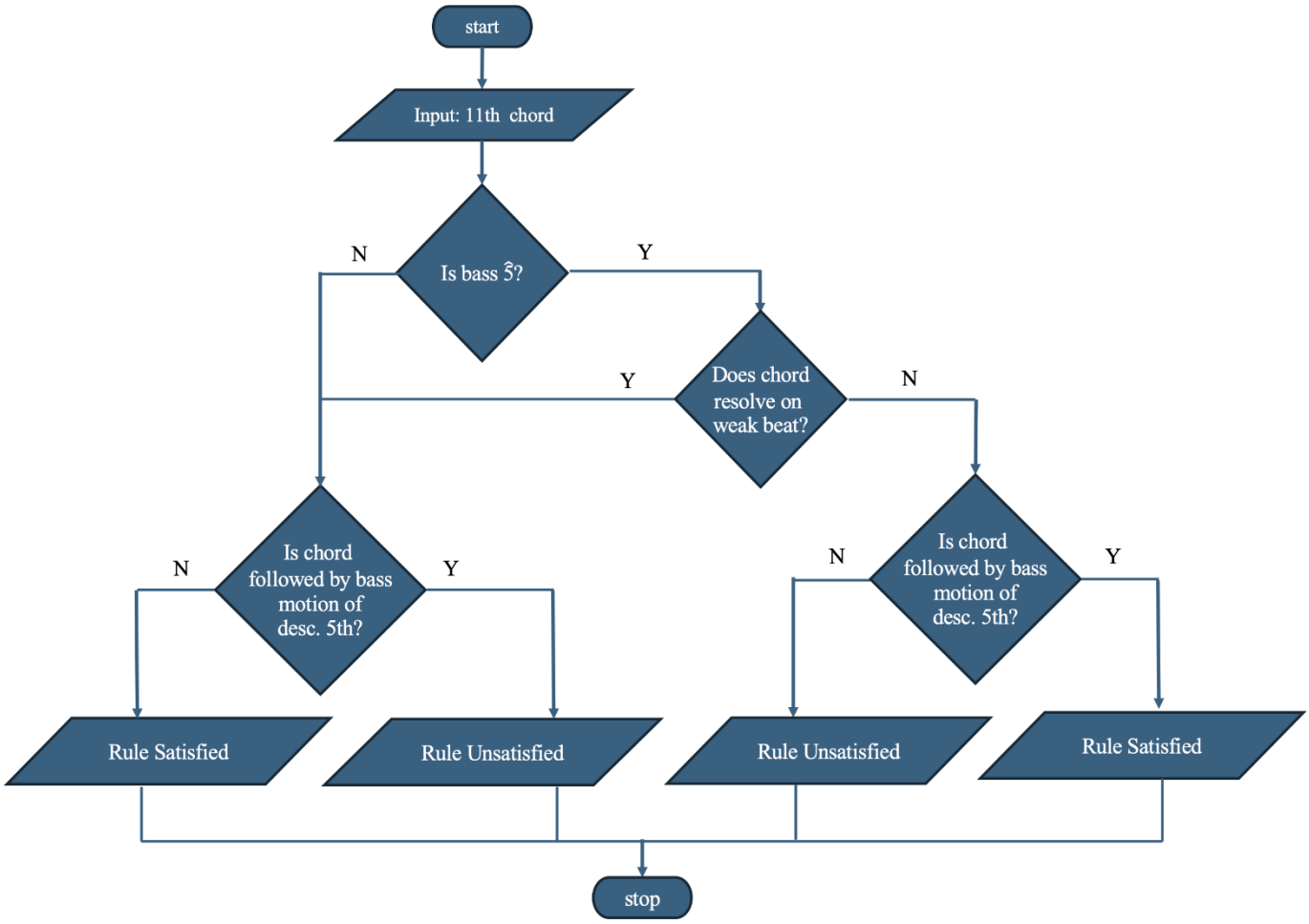
$$Sensitivity = \frac{Rule\ Satisfying\ Resolutions\ by\ \downarrow P5}{Total\ Resolutions\ by \downarrow P5}$$

$$Specificity = \frac{Rule\ Satisfying\ Resolutions\ NOT\ by\ \downarrow P5}{Total\ Resolutions\ NOT\ by\ \downarrow P5}$$

Example 14. Area-proportional Venn diagram for Model A. The gray circle represents eleventh chords followed by bass motion of a descending P5. The red circle represents eleventh chords approached by a descending P5 in the bass voice. The blue circle represents eleventh chords approached by an ascending P5 in the bass voice.



Example 15. Flow-chart illustrating the input and output of Model B.



Example 16. Error matrix for a model (Model B) that predicts resolution by descending perfect 5th if an only if an eleventh chord has $\hat{5}$ in the bass and terminates on a strong beat.

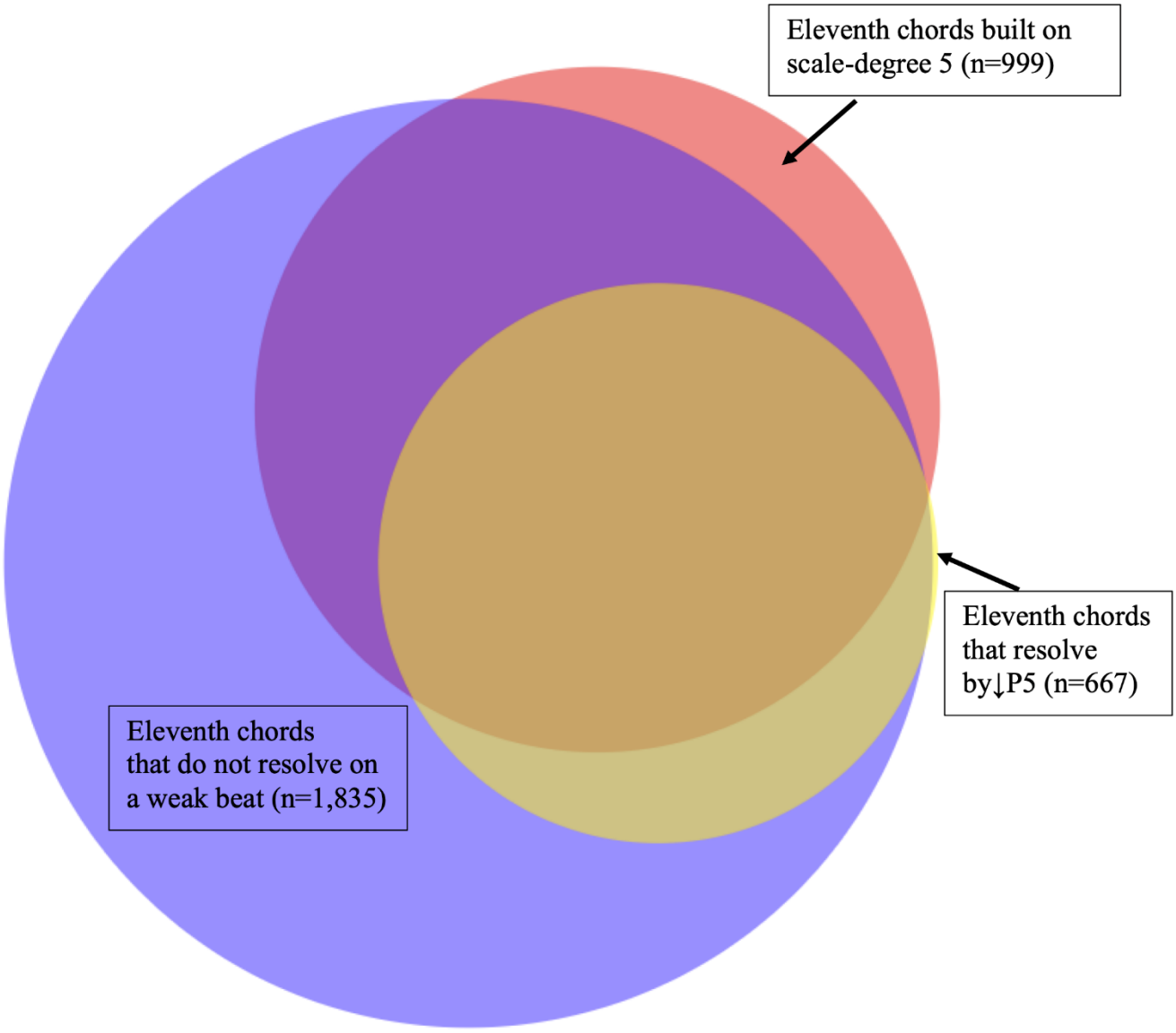
	NOT V^{11}, OR weak-beat termination		V^{11} with strong-beat termination		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	1004	761.95	362	604.05	1366
Resolution = ↓P5	130	372.05	537	294.95	667
	1134		899		2033

$$Accuracy = \frac{1004 + 537}{2033} = 76\%$$

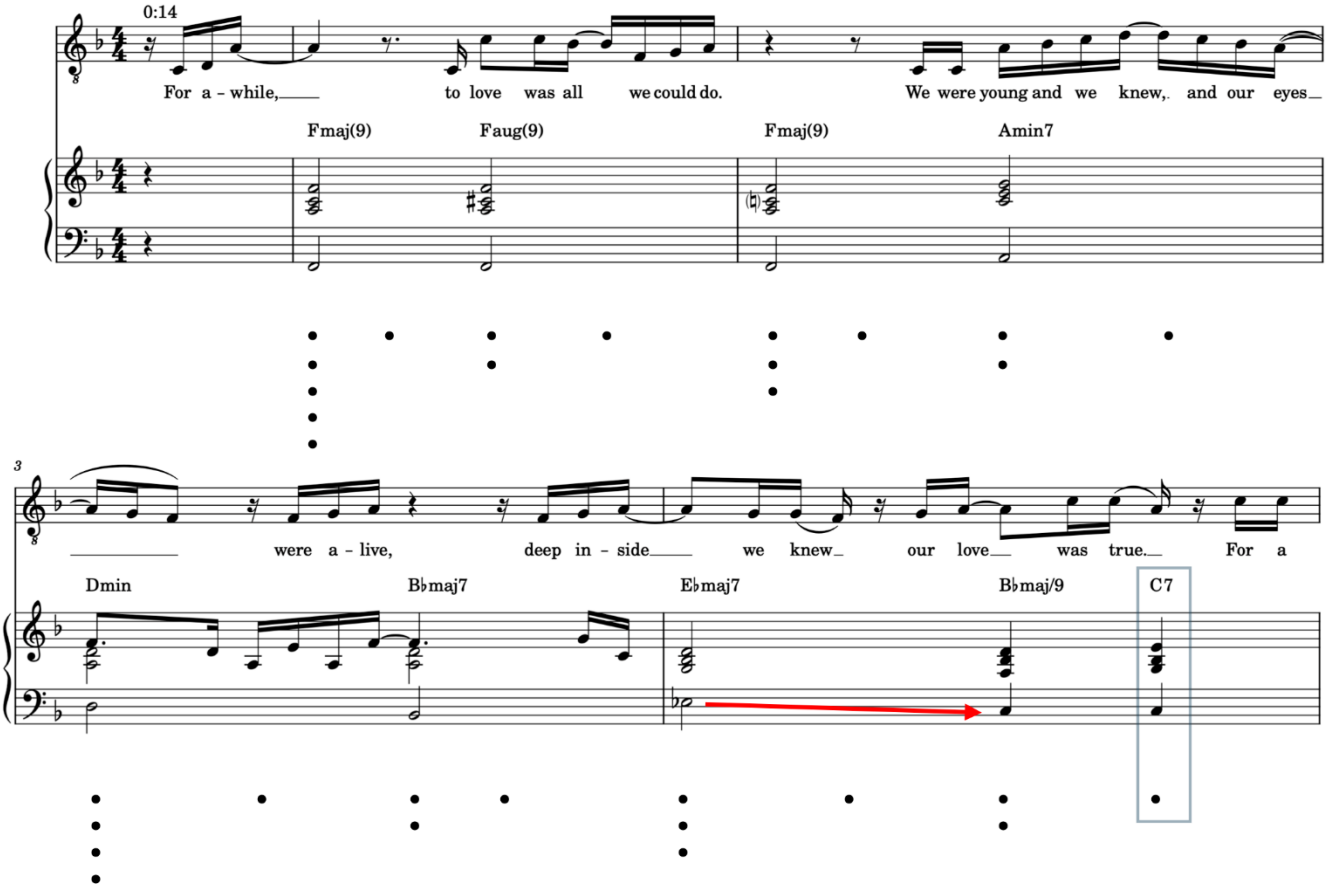
$$Sensitivity = \frac{537}{665} = 81\%$$

$$Specificity = \frac{1004}{1366} = 73\%$$

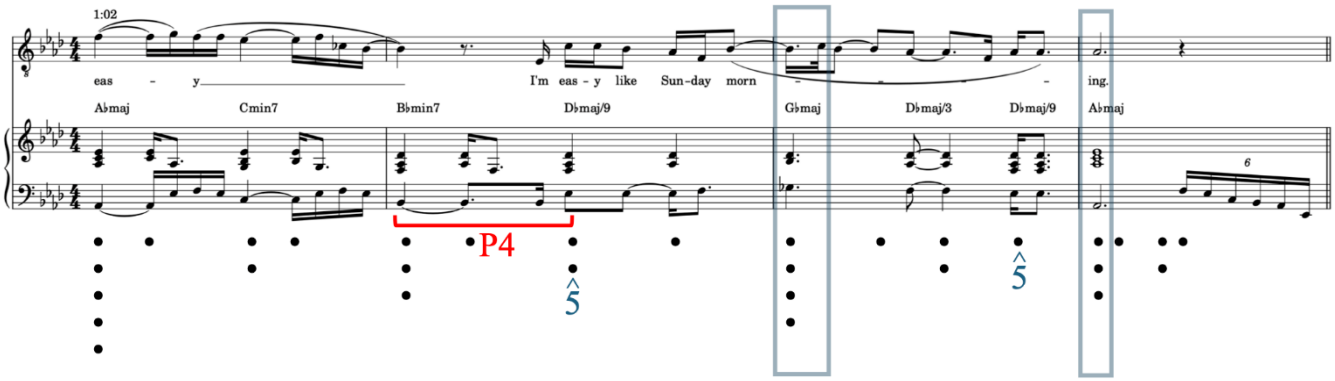
Example 17. Area-proportional Venn diagram for Model B. The yellow circle represents eleventh chords followed by bass motion of a descending P5. The red circle represents eleventh chords built on $\hat{5}$. The blue circle represents eleventh chords that do not resolve on a weak beat.



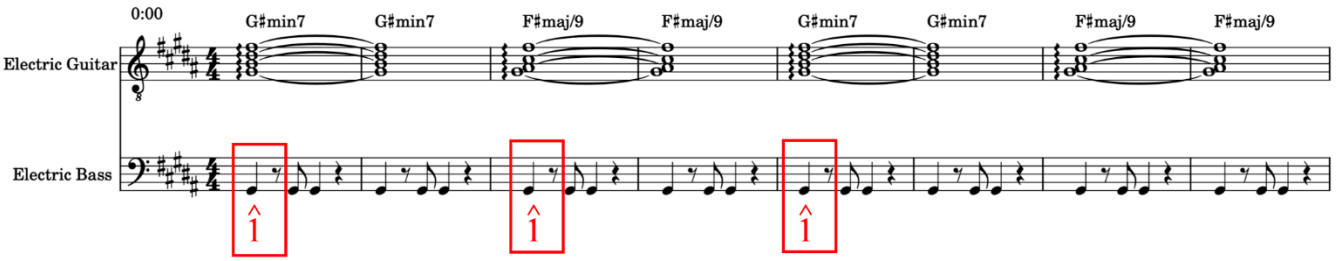
Example 18. The first four measures of the first verse of Earth, Wind & Fire's "After the Love Has Gone" (1979). Both models decline to predict bass resolution by descending perfect 5th (bass of "B♭maj/9" not approached by perfect 4th or perfect 5th; weak-beat chord offset).



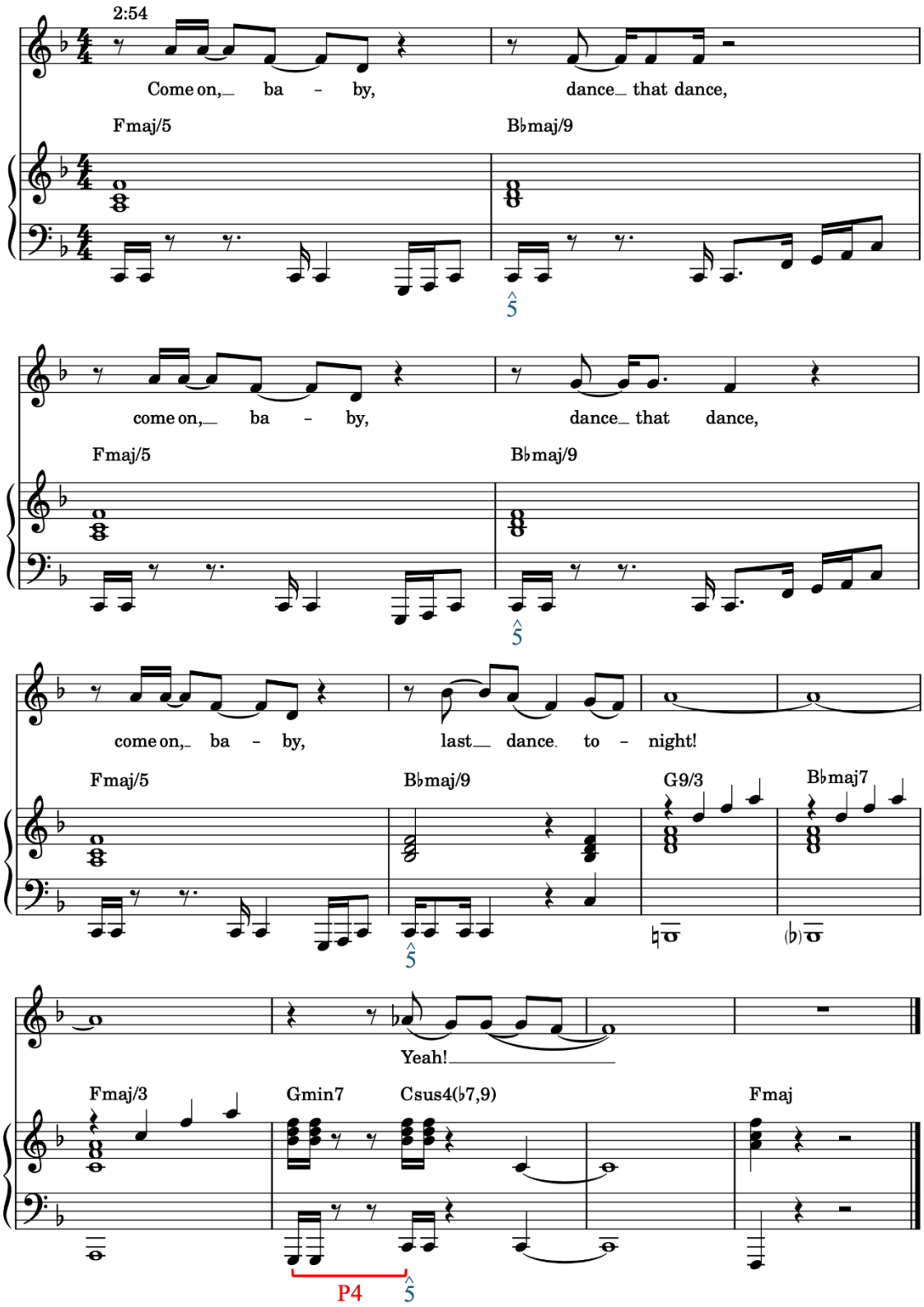
Example 19. The last four measures of the first chorus of the Commodores' "Easy" (1977). Both models incorrectly predict a leap of a descending perfect 5th in the bass across the excerpt's second and third measures. Model B correctly predicts the resolution of the second "D♭maj/9" (across the excerpt's third and fourth measures).



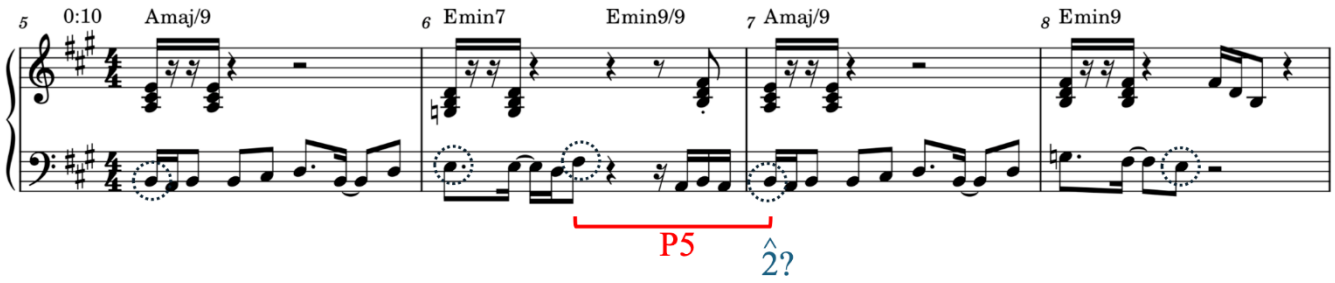
Example 20. The first eight measures of Tina Turner's "What's Love Got to Do with It" (1984). Both models decline to predict bass resolution by descending perfect 5th (bass of "F♯maj/9" is $\hat{1}$ of G♯ minor, approached by common tone from the previous chord).



Example 21. The final twelve measures of Donna Summer's "Last Dance" (1978) generate several incorrect predictions of resolution by descending 5th from Model B and one correct prediction of resolution by descending 5th (final three measures) from Model A.



Example 22. Measures 5–8 of "Dial My Heart" (1988) by the Boys. Dashed circles highlight the bass notes included in the MBC transcription. Model A correctly predicts that a chord with E in the bass will succeed the "Amaj/9" chord in m. 7; Model B declines such a prediction because the transcription does not recognize the bass note of "Amaj/9" as $\hat{5}$.



Example 23. Error matrix for a model that predicts resolution by descending perfect 5th if and only if an eleventh chord is approached by root motion of a perfect 4th or perfect 5th.

	NOT Approached by Root Motion of P4 or P5		Approached by Root Motion of P4 or P5		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	941	814.73	351	477.27	1292
Resolution = ↓P5	341	467.27	400	273.73	741
	1282		751		2033

$$Accuracy = \frac{941 + 400}{2033} = 66\%$$

$$Sensitivity = \frac{400}{741} = 54\%$$

$$Specificity = \frac{941}{1292} = 73\%$$

Example 24. Error matrix for a model that predicts $\hat{1}$ as chord root to ensue if and only if an eleventh chord has $\hat{5}$ in the bass and terminates on a strong beat.

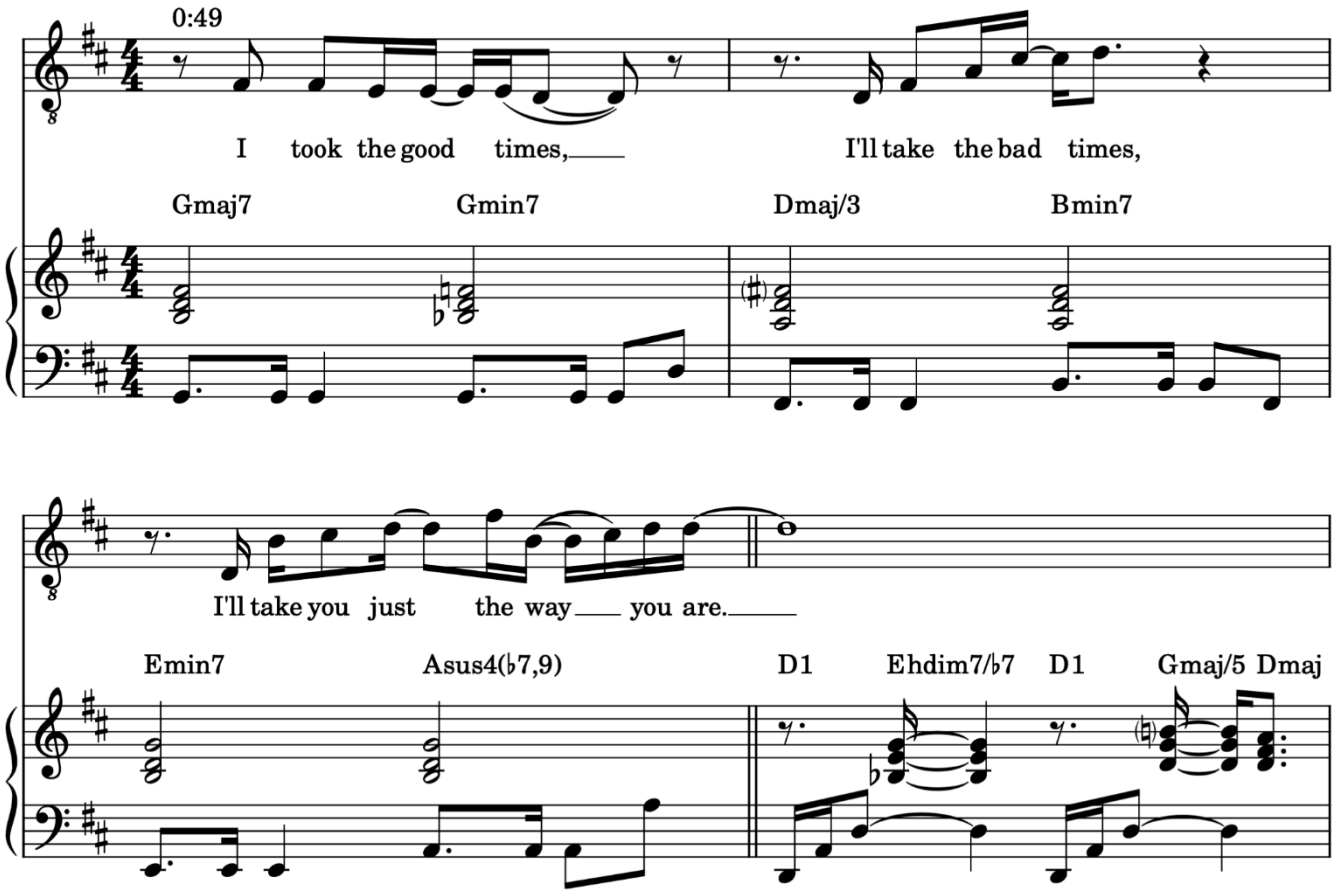
	NOT V^{11}, OR weak-beat termination		V^{11} with strong-beat termination		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	943	720.67	349	571.33	1292
Resolution = ↓P5	191	413.33	550	327.67	741
	1134		899		2033

$$Accuracy = \frac{943 + 550}{2033} = 73\%$$

$$Sensitivity = \frac{550}{741} = 74\%$$

$$Specificity = \frac{943}{1292} = 73\%$$

Example 25. The first verse of Billy Joel's "Just the Way You Are" (1977) concludes with an Asus4(♭7,9) chord; the ensuing interlude begins with a harmony-less bass note (D).



Example 26. Comparison of eleventh chords in the MBC and in Temperley's RS200 transcriptions.

	MBC	**RS200 Corpus**
Songs with eleventh chords	153	19
Percent of songs in corpus with eleventh chords	14.1%	9.5%
Total number of eleventh chords	2,033	193
Eleventh chords per song: average	1.54	0.97
Eleventh chords per song: standard deviation	6.34	4.49
Percent of eleventh chords with $\hat{5}$ in bass (i.e., V^{11})	49.1%	48.1%
Percent of V^{11} chords that resolve with bass motion of descending perfect 5th	53.8%	54.8%

Example 27. Error matrix for Model A applied to Temperley's transcriptions from the RS200 corpus.

	Bass NOT Approached by P4 or P5		Bass Approached by P4 or P5		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	111	97.98	11	24.02	122
Resolution = ↓P5	44	57.02	27	13.97	71
	155		38		193

$$Accuracy = \frac{111 + 27}{193} = 72\%$$

$$Sensitivity = \frac{27}{71} = 38\%$$

$$Specificity = \frac{111}{122} = 91\%$$

Example 28. Error matrix for Model B applied to Temperley's transcriptions from the RS200 corpus.

	NOT V^{11}, OR weak-beat termination		V^{11} with strong-beat termination		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	97	73.96	25	48.04	122
Resolution = ↓P5	20	43.04	51	27.96	71
	117		76		193

$$Accuracy = \frac{97 + 51}{193} = 77\%$$

$$Sensitivity = \frac{51}{71} = 72\%$$

$$Specificity = \frac{97}{122} = 80\%$$

Example 29. Error matrix for Model A applied to major-minor seventh chords in the MBC.

	Bass NOT Approached by P4 or P5		Bass Approached by P4 or P5		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	1214	1346.27	1667	1534.73	2881
Resolution = ↓P5	1815	1682.73	1786	1918.27	3601
	3029		3453		6482

$$Accuracy = \frac{1214 + 1786}{6482} = 46\%$$

$$Sensitivity = \frac{1786}{3601} = 50\%$$

$$Specificity = \frac{1214}{2881} = 42\%$$

Example 30. Error matrix for Model B applied to major-minor seventh chords in the MBC.

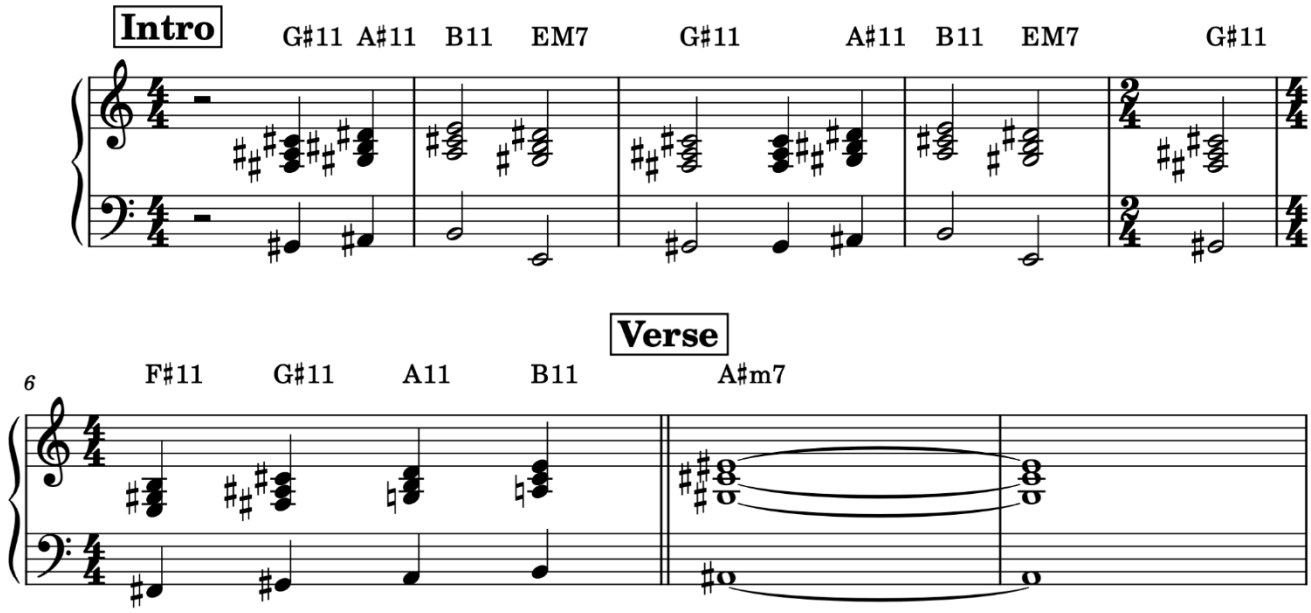
	NOT V^7, OR weak-beat termination		V^7 with strong-beat termination		
	Observed	Expected	Observed	Expected	
Resolution ≠ ↓P5	2100	1654.29	781	1226.71	2881
Resolution = ↓P5	1622	2067.71	1979	1533.29	3601
	3722		2760		6482

$$Accuracy = \frac{2100 + 1979}{6482} = 63\%$$

$$Sensitivity = \frac{1979}{3601} = 55\%$$

$$Specificity = \frac{2100}{2881} = 73\%$$

Example 31. The first eight measures of D'Angelo's "Another Life" (2014). The transcription and chord labels are those of the author.



Example 32. Shares of bass departure intervals from eleventh chords in the MBC. Boldface indicates the intervals used in the excerpt found in Example 31.

↓tt	↓P4	↓M3	↓m3	↓M2	↓m2	P1	↑m2	↑M2	↑m3	↑M3	↑P4
0.9%	2.9%	3.6%	3.6%	**8.2%**	**0.5%**	36.0%	**2.0%**	**8.3%**	0.8%	0.1%	**33.0%**